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1. MANAGEMENT

Gas Industry Management

Peace Returns to the Upper Midwest. *Petrol. Week 9,* 34 (1959) July 24 (2 pp.); **Upper Midwest Gas Needs Cited.** *Petrol. Week 9,* 39 (1959) Aug. 7

Former arch competitors for Upper Midwest (U.S.) customers, Midwestern Gas Transmission Co. (subsidiary of Tennessee Gas Transmission Co.) and Michigan Wisconsin Pipe Line Co., appeared before the Federal Power Commission (FPC) on July 27 with a joint proposal to increase service to the area. Revised plan calls for construction by Midwestern of a 504-mile pipeline from Emerson, Manitoba, to Marshfield, Wis., to import Canadian gas, at a cost of $52 million. Michigan Wisconsin proposes to build a line from Marshfield to Appleton, Wis., to take 153-million CF/day of Midwestern's gas, which it would distribute at points along its line in Wisconsin. It proposes to spend $24,177,000 on this, plus additional mileage and compressor horsepower. Many former opponents, among them People's Gas Light & Coke Co., Northern Indiana Public Service Co. and Northern Illinois Gas Co., appear to have decided that it is better to share the business in the eight-state territory (Illinois, Indiana, Michigan, Wisconsin, Minnesota and portions of North Dakota, South Dakota and Missouri) rather than prolong an apparently profitless battle that began in 1955.

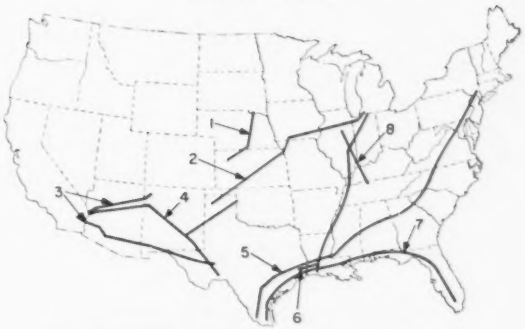
In Case of Attack. H. Bratter. *Public Util. Fortnightly 64,* 199 (1959) July 30 (8 pp.)

It has been assumed that modern weapons will not permit government, in time of attack, to move from Washington to dispersal locations. Plans formulated in 1956 have thus been revised. Now the country is divided up into eight Office of Civil and Defense Mobilization regions with no central government. Article examines three aspects of this new plan in terms of what it will mean to public utilities such as gas, electric power, telephone and communications companies.

Corrosion Prevention Cooperation. C. W. Beggs. *Gas 35,* 58 (1959) Aug. (8 pp.)

Many will undoubtedly agree that the protection of buried utility structures is a successful modern practice. Those who are aware of the possibility of accident as the result of corrosion of gas lines will recognize a desirable safety practice in these modern methods. Limitations of the system of protection are few, provided that it is understood that pipe which is corroded through is ruined although further corrosion can be stifled on such pipe. If the cooperative effort of local utility operators can be secured the corrosion engineer will be able to advance his science and practices to new areas of success. Such cooperation would doubtless set the stage for other regional protection plans, such as outlined in the article. For the accomplishment of such plans, corrosion engineers need management approval, a dynamic corrosion committee and sufficient funds.

1959 Pipeline Construction in the United States



1. KANEB PIPE LINE: 279 MILES OF 6 IN. EXTENSION FROM KANSAS TO SOUTH DAKOTA
2. MICHIGAN WISCONSIN: 400 MILES OF MOSTLY 24 IN. BETWEEN TEXAS AND MICHIGAN
3. EL PASO NATURAL: 900 MILES OF LOOPS AND FIELD LINES IN TEXAS, NEW MEXICO AND ARIZONA
4. TRANSWESTERN PIPELINE: 1800 MILES OF LINE FROM TEXAS TO CALIFORNIA
5. TRANSCONTINENTAL: 975 MILES OF LOOPS FROM TEXAS TO NEW YORK
6. TRUNKLINE GAS: 900 MILES OF LOOPS AND EXTENSION FROM TEXAS TO MICHIGAN
7. COASTAL TRANSMISSION-HOUSTON: 2500 MILES OF LINE FROM TEXAS TO MIAMI, FLA.
8. MIDWESTERN GAS TRANSMISSION: 350 MILES OF 30 IN. FROM PORTLAND, TENN., TO JOLIET, ILL.

(Adapted from *Midyear Report.* See Abstract, p. 246)

How to Preserve Vital Records. *A.G.A. Monthly 41,* 20 (1959) July-Aug. (3 pp.)

In a report by the A.G.A.-EEI General Accounting Committee on the preservation of vital information to permit reconstruction of records after a catastrophe, the subcommittee states that this subject must be studied by management now—particularly from the viewpoint of providing safeguards against loss through enemy air attacks. During the committee's research, the Baltimore Gas and Electric Co.'s "Vital Records Program" was studied. Company has in effect a records protection program designed for 1) fire, flood and other ordinary hazards; 2) protection for insurance purposes, and 3) a records retention program to comply with the state and federal regulatory requirements.

Gas Industry Expansion

Natural Gas — Canada's Awakening Giant. J. Davis. *Gas Age 124,* 19 (1959) July 23 (5 pp.)

Now that Canada's gas industry has come of age via completion of major cross-country pipelines, those connected with it have begun to take a more than routine interest in field prices, transmission costs and distribution investment. Author believes that as far as price goes, gas will become relatively more attractive to the average Canadian customer. Field

prices may rise, but economies of transmission and distribution should help to keep things on a fairly even keel. Other goods and service may not be so fortunate. Coal will cost more as wages increase; oil, though less vulnerable, also may feel the effects. Natural gas, meanwhile, may be one of those rarities in modern economy whose price is not inversely proportionate to the (declining) purchasing power of the dollar.

Research

Today's Research Needs Set at $4 Million a Year. H. A. Eddins. *A.G.A. Monthly 41,* 14 (1959) July-Aug. (5 pp.)

A.G.A. Board of Directors, in June, 1958, recommended that an appropriate organization be engaged to conduct a broad study of the present and future needs of the gas industry. Study, conducted by specialists at Battelle Memorial Institute, was to include recommendations as to the proper scope and financial requirements of a research program. Based on a study of competitive energy industries, potential natural gas supply and demand patterns, growth opportunities, and competition in the appliance and equipment markets, and on application of judgment resulting from long experience in industrial research, specialists recommended that the annual budget for A.G.A. research be expanded to $4 million at the earliest possible date. A goal should be established to expand the PAR research effort to $6 million annually as soon thereafter as is practicable—at least by 1965—to stay ahead of competition.

Research Business vs Research Institutes. R. W. Truesdail and C. A. Dunn. *Ind. Research 1,* 52 (1959) Summer (10 pp.)

Side-by-side articles by spokesmen for each type of facility centers on basic and applied research and the tax-exempt privilege. Business believes that universities and research institutes that enjoy the privilege of tax exemption should conduct basic research to the exclusion of applied research. The latter group believes that all research is too vital to industry to be curtailed, and since their objective is not only to conduct research but to supply adequately trained personnel, arbitrary restrictions on the type of research accepted would hinder this function.

Competition

Battle of the Fuels—Who's Winning? C. E. Skinner. *Oil Gas J. 57,* 142 (1959) July 27 (5 pp.)

Article discusses Gulf Oil's extension of the Bureau of Mines Information Circular No. 7657, "Fuels Consumed for Residential and Commercial Space Heating 1935-51." Article includes predictions for 1968 based on a population (Bureau of Census estimate) of 205,800,000 and a per capita demand for residential-commercial energy of 566 therms (about 10% more per person than in 1957). On this basis, the total therms required in 1968 would be 116,483 million. This would be a 23% increase over 1957. A.G.A. estimates the residential-commercial demand for gas in 1968 at the equivalent of 64,770 million therms and the Edison Electric Institute believes their demand in the same year will be the equivalent of 14,126 million therms. Should these forecasts be realized gas would have some 55.6% of the total U.S. residential-commercial energy demand and electricity 12.1%. The two combined would then have 67.7% of the market leaving 32.3% for oil, coal and all other fuels compared with their 56.5% share in 1957. If these forecasts become plans and the plans are realized, or substantially realized, painful adjustments will be required on the part of oil and coal.

Federal Power Commission

What the Zwerdling Decision Means to Independent Gas Producers. H. D. Ralph. *Oil Gas J. 57,* 156 (1959) July 27 (7 pp.); **Phillips Blasts Zwerdling Decision.** *Oil Gas J. 57,* 62 (1959) Aug. 10 (2 pp.)

Article outlines Federal Power Commission (FPC) examiner's decision in the Phillips gas case in nontechnical terms so that an independent producer can 1) find his way around the 217-page document; 2) understand the major issues as they are appealed to FPC and the courts, and 3) realize what he faces if the Zwerdling reasoning is upheld and is applied in other cases. In his decision, examiner Joseph Zwerdling has given the FPC a formula for determining just and reasonable prices for independent producers to use in selling natural gas to interstate pipelines. He applied the formula to Phillips Petroleum Co. and got a rate schedule averaging $0.11.66/MCF for pipeline-quality gas delivered to a trunk line. Decision has been bitterly contested and may set many precedents. Final decisions of the five FPC commissioners will be written after oral arguments to the exceptions are heard this fall. No matter what the outcome, decision is the first specific outline—good, bad or indifferent—of how to go about handling a case like this before the FPC.

Foreign Activities

The Independents Grow Tougher in Canada. *Petrol. Week 9,* 40 (1959) July 31 (6 pp.)

Canada is developing a tough breed of well-heeled independents, one that will be in the thick of the oil hunt for a long time to come. Operators still going strong are predominantly Canadian. Good portion of independents' activity is directed to wildcatting.

In the nine-year period, 1949-57, independents drilled more than 45% of the new-field wildcats in Western Canada. This group is even more aggressive in developing the country's oil discoveries. Reason that these independents are tough is that in the past, weaker firms have failed. Shut-in natural gas capacity does not improve the producers' status. There are more than 800 capped gas wells in Alberta alone. This is an unproductive investment of about $150-million. However, there is optimism that new gas markets will open up in the U.S. and at home next year.

The Pipeline in the French Petroleum Industry. A. Genthial. *World Petrol. 30,* (Sect. II) France 47 (1959) June.

Brief history of the construction of the LeHavre-Paris pipeline, which was brought into operation in 1953, and the new problems brought about by the recent discoveries of oil fields at Edjele and Hassi-Messaoud in the Sahara with a description of the pipelines constructed.

Osterreichische Mineralol Veraltung. (Austrian Mineral Oil Administration.) *World Petrol. 30,* (Sec. II) Austria 4, (1959) June (4 pp.)

Osterreichische Mineralölverwaltung A.G. is the main producer of crude oil (95%) and natural gas (99%) in Austria, and during 1957, 68% of the total Austrian oil consumption was refined in its refineries. Following the handing over of formerly Soviet administered oil plants and installations to the Administration, serious problems had to be solved. Special attention was directed to natural gas economy as—until 1955—about 44% of the gas produced could not be utilized. Completion of an expanding network of pipelines, equipped with modern compressors, as well as gas drying installations and the setting-up of pressure-reducing and degassing stations allowed the reduction of losses to negligible amounts. It may be stated that such modernization and rationalization also extended to quite a number of other sections.

Pipeline Systems

Annual Directory of Pipelines, 1959-60. *Pipe Line News 31,* 26 (1959) July 15 (230 pp.)

Annual edition of the directory is divided into nine sections. Categories and features are: *Crude oil pipelines* (35 pp.), *products pipelines* (16 pp.), *natural gas pipelines* (78 pp.)—each of these contains an alphabetical listing of companies and includes personnel and facilities of each; *underground gas storage fields* (8 pp.)—alphabetical directory of companies and personnel operating underground gas storage facilities; *engineering services* (4 pp.)—alphabetical listing of firms and individuals providing various engineering services to the oil and gas pipeline industry; *foreign pipelines* (10 pp.)—alphabetical listing, first by company and then by firm, of latest obtainable information on crude oil, petroleum products and natural gas pipelines operating in countries outside of the U.S. and Canada, excluding the "Iron Curtain" countries; *pipeline buyers guide* (39 pp.)—guide to manufacturers and suppliers of equipment used in construction and operation of oil and gas pipelines; *new pipeline companies* (7 pp.)—comprised mainly of new natural gas, products and crude oil pipeline operators who have not been included in prior issues of the directory, and *index of equipment* (33 pp.)—alphabetical product classification of manufacturers of all types of pipeline equipment.

U.S. Pipelines: History and Development. 1. Petroleum Pipelines. *Petrol. 22,* 248 (1959) July (4 pp.); **2. Brief History of Natural Gas Transmission.** P. G. la Grone. *Ibid.,* 251 (1959) July (3 pp.)

In the first article, brief history of early pipelines and postwar pipelining is given along with a discussion of new methods and corrosion problems. Future expectations are also presented. In part 2, author cites first industrial use of natural gas in 1872 by a pottery concern in East Liverpool, Ohio. By 1925, natural gas service was being rendered in 23 states, the total volume marketed being 1141.5 billion CF, one-third of the consumption 20 years later. Author mentions pressurized pipe and oxy-acetylene welding as technological advances which hastened the availability of natural gas transmission.

Methane Liquefaction

Ocean Transport of Liquid Methane. J. A. Murphy and C. G. Filstead. *Gas Age 124,* 23 (1959) Aug. 6 (6 pp.)

Successful transport of 32,000 barrels of liquid methane from the U. S. Gulf Coast to Canvey Island, England, in February 1959 by the M/V "Methane Pioneer" has established the feasibility of transferring natural gas by tanker over great distances. From its intensive engineering studies over the past five years, Constock International Methane Limited has concluded that liquid methane transport by tanker is economically attractive only where pipeline transmission is impractical or uneconomic, such as across oceans. This method of transporting natural gas from countries in which it is a surplus commodity to areas which have been dependent on gas manufactured from coal or oil is destined to have an important effect on the world energy market. The properties of liquefied natural gas and the requirements for the materials of construction to contain it

are reviewed in the light of Constock's experience. It is pointed out that the transport of liquefied natural gas is less hazardous than transporting gasoline or fuel oil. A general description of the Methane Pioneer is included.

Customer Service

Build a Summer Service Business. *Gas Heat and Comfort Cooling 10,* 28 (1959) July (6 pp.)

One of the most common entries into gas heating service work is through off-season maintenance inspections. Field is more or less wide open in almost any territory, even in areas where servicing is still on a so-called "free basis" and performed by the gas company. This particular type of maintenance is rarely performed by the utility. Where it is done, it is very limited and inadequate. Safety, rather than comfort, is the keynote. Items which require special service include heat exchangers, burners, regulators, vent systems, thermostat, safety pilot and other accessories, and unit and water heaters.

A Guide to Training Servicemen. Part 4. Central Heating Equipment. R. H. Haas and G. C. Miller. *Gas 35,* 66 (1959) Aug. (4 pp.)

Many heating plant troubles are beyond simple remedies and often major installation changes are necessary to correct the situations. Regardless of the scope of the problem, one thing is certain—the customer serviceman must be able to analyze and correct whatever problem is encountered. This ability to analyze and correct is developed only through a competent and extensive training program. Authors believe that a competent gas heating serviceman must be familiar with: 1) Why the human body needs supplemental heat; 2) method of supplying supplemental heat (residential); 3) design and application of gas-fired heating sylstems; 4) automatic controls and control circuits for heating equipment, and 5) analyzing and correcting the customer's problems.

Conveyor in Customer Service Office Speeds Order Handling at Laclede Gas. *Gas Age 124,* 34 (1959) Aug. 6 (2 pp.)

Engineered system provides relatively inexpensive, easily maintained transmittal method handling standard IBM cards and forms. Four belt conveyors, which discharge onto the receiving belt, transverse Laclede's customer service office with desks and file cabinets conveniently placed on each side. High rate of conveyor speed permits forms to travel from the farthest point in the office to the classification area in only one minute.

Cost Accounting

Include Inflation in Cost Accounting. F. C. Jelen. *Petrol. Refiner 38,* 113 (1959) July (4 pp.); **Don't Forget to Allow for Inflation.** *Chem. Eng. 66,* 74 (1959) Aug. 10 (4 pp.)

Concept of an allowance for inflation is an engineering approach to the problem of a varying unit. Tools of management, such as the income statement and the balance sheet, use the current dollar as an expression of value. However, such forms, directly and indirectly, contain dollars of other years and other values. It is not practical to use a fixed dollar as a fixed base since it is only the current dollar which has current meaning. Corrections must be made to keep up with the changing base of the depreciating dollar. Corrections are true expenses—hidden expenses arising from inflation.

How to Distribute Auxiliary Costs. W. H. Stanton. *Petrol. Refiner 38,* 110 (1959) July (3 pp.)

Method for allocating auxiliary capital and costs for process plants is based on the percent of the total utility required by the product plant operating at rated capacity.

Petrochemicals

Locating Tomorrow's Chemical Plants. H. E. Wessel. *Oil Gas J. 57,* 106 (1959) July 13 (4 pp.)

Next ten years will probably witness some sharp changes in the chemical industry. Chemical market research will play an important part in plant design and location. Many future customers are not going to be old customers, so researchers will have to study unfamiliar markets. However, by projecting the increase in annual sales for the next decade for major subgroups of the chemical industry, a broad picture of what types of plants will be built and the relative quantity of each group can be visualized. It is from such data that plant design and location will be determined.

UK Petrochemical Output Rises 165% in Five Years. *World Petrol. 30,* (Annual Refinery Rev.) 71 (1959) July 15 (4 pp.)

Recent OEEC report, "The Chemical Industry in Europe," puts production of organic petrochemicals (expressed in tonnage of the carbon content) in 1957 as 271,000 tons, an increase of 26% over 1956, and estimates the 1958 total as around 323,000 tons. It might have been expected that the latter figure would have shown a higher rise over 1957, but the answer probably lies in the fact that several major new plants were only working into normal production in the second half of 1958. Tabular summary of the rise in output since 1953 is included. OEEC figures for this table are based on a census contributed by manufacturers.

Developments and Prospects of Petrochemistry in West Germany. A. Metzner. *World Petrol. 30,* (Sect. II) Germany 54 (1959) June (4 pp.)

Among the important petrochemical operations in Federal Germany are production of olefins, production of synthetic gas to manufacture ammonia, methanol, and its byproducts, conversion of methane, and production of acetylene from liquid raw materials. In contrast to the USA, Germany's combined domestic and imported crude and partly refined oils have not yet brought about sufficient consideration of the complicated chemistry of aromatics or heterocyclics. Organic dye substances or vitamins are not petrochemically produced. On the other hand, cleaning substances and most plastic raw materials with simple chemical structures are typical goals for petrochemistry. Importance of petrochemistry in Germany is seen from the fact that in a few years nearly a billion DM has been invested in the industry. Future development is expected to move in various directions. Of most immediate importance is plastics because of the great variety of new items produced by the chemical industry for daily life.

Information

The Conversion of Domestic and Commercial Appliances. Preparing Conversion Cards. C. DuPont and J. Rouet. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (26 pp. French text.)

Test and Research Center at Gennevilliers and the Gas-Changeover Center have undertaken in common a study of the conversion of domestic and commercial appliances with a view to utilizing gases other than the one for which they were designed. This study was conducted in such a way as to enable cards to be drawn up in which personnel in charge of conversion operations would be able to find all necessary data for the job. The first part of the report indicates the methods used to carry out these conversions and examines a few of the appliances converted. Some examples are given, specially selected so as to better underline the procedure followed. In the second part, a detailed examination is made of the studies conducted with a view to solving the difficulties frequently encountered in connection with appliances, and some indications are given of how the results obtained can be used to convert appliances for which no specific conversion cards have been formulated.

Prodigy with a Flair for Profit. *Business Week 1559,* 78 (1959) July 18 (4 pp.)

Some 14 years ago, Vannevar Bush predicted a wondrous device, no bigger than a desk, capable of storing books, pictures, maps, letters and memoranda at the rate of thousands of pages a day for hundreds of years. Moreover, it would retrieve and display any document or combination of documents almost instantly by associating logically connected facts as does the human brain. While this device is not yet available, a number of companies and research laboratories are working to make it a reality. One of these, Itek Corp., Waltham, Mass., is subject of this article. Itek specializes in information technology. One of its fundamental theses is that most business and scientific information today occurs in graphic form—consisting in large part of words and drawings that cannot be readily translated into computer language. Its special field is concerned with the problem of storing and rapidly retrieving such items. Essentially what it is offering is an entire system capability—oriented to each customer's needs—covering the acquisition, handling, evaluation, filing, indexing, abstracting, storage analysis, retrieval, display, reproduction, updating and dissemination of graphic information.

Offshore Operations

What Is the Outlook for Drilling in the Gulf of Mexico? J. Zeppa. *Drilling 20,* 59 (1959) July (2 pp.)

Author foresees improvement in the rate of operation in the offshore area as new methods of drilling and production are developed which result in lower costs. Some improvement may be hoped for from a reduction in the number of available operating units. Tenders owned by producers, now partly decommissioned, will probably not see service again. Substantial number of submersible and self-elevating units have left the Gulf Coast for foreign waters, probably never to return. As transportation facilities in the form of pipelines for both oil and gas, particularly the latter, are completed, the revenue from the reserves already discovered should assume a more important factor in the profit and loss statement of offshore operations. Another element which should help to increase the operating ratio is the availability of farmouts.

Maintenance

"Paintenance," Proper Painting Maintenance, Is Success-Key for LPG Business. M. E. Spatz, *Butane-Propane News 21,* 34 (1959) Aug. (7 pp.)

"Paintenance"—art of maintaining property through proper painting policies—can be a highly important key to business success—especially for the LPG business. Dealing with an invisible product, such as LPG, most tangible objects customers can sometimes see are the containers for the product. Moreover, major investment in metal is lost through deterioration unless these products are painted. Author covers all aspects of paintenance—when to paint, paint selection, painting different types of objects, methods of painting and estimating the amounts needed. Objective of such a program is to protect investment and

cut maintenance costs besides retaining and building customers.

2. ENERGY SUPPLY AND ECONOMICS

Gas Reserves

California's Hottest Gas Area Is Getting Hotter. F. B. Loomis. *World Oil 149,* 96 (1959) Aug. 1 (3 pp.)

Gas play is increasing at a record-breaking pace in northern California's Sacramento basin. To date: Drilling activity has increased 100% during the first six months of 1959. Sixty wells, half of them wildcats and the rest step-outs and new pay efforts, were completed. Fourteen rigs are currently in operation. Eighteen more tests have been staked and will be started as soon as rigs are available. There are now 40 producing gas fields in the area. Cumulative production to January 1, 1959, has totaled 2,417,500 MMCF of gas. During 1958, production amounted to 115,692 MMCF. Reserves are estimated to total more than 2.1 trillion CF or about 18 years' supply at the present rate of production.

How Successful Are Gas-Well Discoveries. C. W. Blanpied. *Oil Gas J. 57,* 176 (1959) July 13 (2 pp.)

Digest of a report by the Committee on Statistics of Exploratory Drilling of the AAPG indicates that only about 45% of the so-called "successful" gas discoveries in the U.S. result in reserves that may be considered profitable. Committee took its cue from an original study made in 1958 (see *Gas Abstracts 14,* 223). Current report, which covers the decade 1943-53, is first attempt to credit reserves to the year of discovery of individual fields.

Saudi Arabian Gas Offered for Sale. *Oil Gas J. 57,* 61 (1959) Aug. 3.

Aramco, which produces more than a million barrels of oil/day in Saudi Arabia, claims gas supplies of 163,000,000 CF/day available at present, with supplies rising to 201,000,000 CF/day and 214,000,000 CF/day in 1960 and '61, respectively. Sales pitch is aimed at potential industrial customers for Saudi Arabia. In a brochure company expresses hope that low price and favorable contract terms will tempt new industries to Saudi Arabia to use the gas for fuel, chemical processing and any other purpose.

Petroleum

Midyear Report. *Oil Gas J. 57,* 119 (1959) July 27 (23 pp.)

Operators plan to drill 27,595 wells in the last half of 1959, including 5568 wildcats and 22,027 development wells. Wildcat completions will be up 1051 wells over the total for the first half. Development drilling will show a gain of 2177 wells over the first half, for a total increase of 3228. Total completions for the first six months of the year amounted to 24,367 wells for a gain of 1379 over 1958. Increase came from development drilling—wildcat completions were down 39 wells. Domestic demand for petroleum products gained 6.4% over the poor showing for the first half. Average demand for the year is expected to be up 5.0%. Refined product imports hit an all-time high of 1,259,000 bbl/day in the first quarter of 1959, but declined in the second quarter under quota limitations. Crude imports averaged 916,000 bbl/day for the half, down 2.4%. Crude production averaged 7,180,100 bbl/day for the first half, but still lagged 1957. Gain over last year was 11.1%. World production was up 10.4%. Output from natural gasoline and cycling plants averaged 35,856,000 gal/day for a gain of 9.6%. Refiners ran 7.9% more crude in the first half than last year to set a new first-half record of 8,036,000 bbl/day. Resulting overproduction put pressure on product market. Pipeline construction may reach 16,500 miles in 1959. Total will top 1958, but will be far short of the 1957 record. Emphasis in refinery construction is on alkylation.

Trends of Oil Economics and Their Influence on the European Energy Market. L. Corradini. *World Petrol. 30,* (Sect. II) Europe 5, (1959) June (2 pp.)

Numerous factors change the bases of the problem of limiting imports through the application of an accelerated nuclear program. This means that the economics of such a program must be measured on the "petroleum level" and not on the "coal level." These factors are: 1) Enormous reserves of petroleum and natural gas, most probably available at advantageous prices; 2) necessity for the OEEC countries, which are drastically committed to long-term economic competition, to profit by the productivity advantages offered by the use of oil in several sectors of industry; 3) unlimited investments necessary to meet the requirements of the Common Market; 4) necessity to institute freedom in the exchange market in order to assure economic expansion of the Community, which by its very structure is short of energy sources and essentially engaged in the processing of raw materials, and 5) the economic interdependence to be anticipated between industrialized countries and underdeveloped, but oil producing, countries.

Development of the Italian Petroleum Industry. E. Mattei. *World Petrol. 30,* (Sect. II) Italy 3 (1959) June (6 pp.)

In coming few years, petroleum industry will be called upon to provide the bulk of new energy re-

quirements. For example, in 1938, primary sources of energy contributed to whole energy supplies as follows: Solid fuels, 59.43%; water and natural steam produced electricity, 32.15%; liquid fuels, 8.36%; natural gas, 0.06%. In 1957, these figures had been redistributed as follows: 17.60%; 24.70%; 46.60% and 11.10%. The Po Valley and Sicily are the areas which count the most for production. In 1957, 1,261,540 tons of crude oil were produced in Italy (mainly drawn from Sicily), 65,934 tons of gas condensate from the Po plain, and 4,987,075,000 CM of gas drawn almost completely from there also. In 1958, the respective figures had altered to 1,534,358 tons of crude oil, 64,927 tons of gas condensate and 5,176,000,000 CM of gas.

Fuel Cells

Profit Potential Sparks Fuel Cell Scramble. *Chem. Week 85,* 45 (1959) July 25 (4 pp.)

Military interest in fuel cells has sparked a number of all-out development projects that are rapidly bringing these 150-year-old scientific oddities to the threshhold of commercial application. Several fuel cell systems—hydrogen-oxygen, molten-salt, redox, regenerative, consumable-electrode, ion-exchange—promise profitable application in power generating plants, ranging from large central stations to portable units and suitcase-size automotive power systems.

Electricity

Trends in Electric Heating. R. A. Collinge. *Coal Utilization 13,* 18 (1959) July (4 pp.)

Retail coal dealer must realize that electric heat is not just a possibility—it has arrived and cannot be ignored. Competition will be confined, for the most part, to new construction. Electric heat offers an excellent opportunity to stop the inroads of oil and gas into the home heating market in many regions. Nothing prevents a retail coal dealer from branching out into the allied fields of heat pumps or resistance heating. Neither is there an exclusive monopoly of the local electric utility or appliance dealer, and already several retail dealers have decided to merchandise the heat pump, with good results. Rise of electric heating means an increasing use of electricity to power other home appliances—a move away from gas ranges, etc. Generation of electricity requires the burning of vast quantities of coal—and this market has become the hope (coal by wire) of the future for coal.

Steam-Electric Plant Factors 1958. An Annual Study by the Department of Coal Economics. Ninth Ed. (Washington: Nat. Coal Assoc., 1959, July.) (40 pp.) $1.00.

Publication represents ninth annual study to be issued on steam-electric plant factors, prior studies having covered the years 1950 through 1957. Primary purpose of reports is to provide, on an individual plant basis, as complete data as are available from the Federal Power Commission (FPC) on the subjects of installed capacity, net generation, excluding station use, fuel consumption and costs, and capacity of new plants, or additions to existing facilities programmed for or under construction. Study is designed to cover all of the continental United States' publicly- and privately-owned steam-electric utility plants which file annual reports with the FPC. A few plants were necessarily omitted where either the fuel information was not complete or the report was not on file. Data are presented in six tables and two charts for 738 steam-electric stations by states and regions. New capacity to 1962 is tabulated.

Foreign Activities

Lacq Gas as a Factor of French Economic Prosperity. A. Blanchard. *World Petrol. 30,* (Sect. II) France 25 (1959) June (4 pp.)

To make Lacq gas marketable, the Societe Nationale des Petroles d'Aquitaine (SNPA) has installed processing plants to 1) separate the H_2S and CO_2 present in the crude gas; 2) extract the sulfur contained in the H_2S gasoline extraction, i.e., separation of the propane, butane and gasoline from the purified gas. First section of this plant was put onstream in May 1957; by the end of 1960, capacity will reach 20 MMCM/day. For transporting the Lacq gas to supply areas, establishment of a system of large diameter pipelines has been undertaken; their total length will be 1500 km, exclusive of the branch lines to be connected to the network. When the production rate of 20 MMCF/day of crude gas is attained, the various operations carried on in the Lacq processing plant will lead to the annual supply of: 4 billion CM of purified gas (methane); 130,000 metric tons of propane and butane; 250,000 metric tons of gasoline and 1,400,000 metric tons of sulfur.

Oil and the French Economy. J-M. Jeanneney. *World Petrol. 30,* (Sect. II) France 3 (1959) June (3 pp.)

Although the problems were complex and many, it was generally accepted that, after World War II, no economic and social revival could be effected without oil. Thus, France, in accordance with plans made before the war, proceeded to reconstruct and modernize her distribution network, her fleet of tankers, her refining industry and technical schools, and the conditions under which she was led to enter upon the decisive phase of her petroleum policy by prospecting the extensive sedimentary deposits in the

franc area. Today, results achieved by France in the matter of oil are exceptionally outstanding. Oil consumption of the French Community, now 30 million tons/annum, has more than doubled since 1950 and is six times that of 1945. Constantly enlarged in proportion to the requirements of the entire franc area, French refineries supply practically all the products consumed and also work for the export market.

Oil Is Not Everything—A Realistic Appraisal of Venezuela's Present Situation. J. P. P. Alfonso. *World Petrol. 30,* 36 (1959) July (4 pp.)

From 1917-1958, production totaled 11,818 million barrels, a figure equal to 71.7% of proved oil reserves of Venezuela, as of December 31, 1958 (16,500 million barrels). Total value of the 41-year production amounted to $24,595 million (all figures in terms of U.S. dollars). Fiscal income for the nine years of dictatorial regime (1949-57) amounted to $8576 million, oil being responsible for 63.0% of that amount or $5430 million. But while exports have been high, imports for goods and services have been even higher. A nation must determine how to put more of its own energy to work at home before it can embark on the road to material success. That is why, after nine years of a dictatorial government, Venezuela was a bankrupt nation. During that period the oil industry, run by foreign interests totally indifferent to the economic situation of the country, reaped profits.

The Development of Crude Oil and Natural Gas Production in the Federal Republic of Germany. H. Pfefferkorn. *World Petrol. 30,* (Sect. II) Germany 12 (1959) June (2 pp.)

Year 1943 brought the discovery of the oil horizons of the Emsland, the following fields of which experienced the greatest postwar development: Georgsdorf, Emlichheim, Rühlermoor and Rühlertwist. A continuous increase in the number of new producing fields as well as total production began in 1950, finally leading to a total of 4,431,596 tons from 82 fields in 1958. At present, there are in operation 15 structurally independent natural gas fields with approximately 70 producing dry gas wells. Annual production of these fields in 1957 was 357 MMCM; in 1958, this figure declined to 344 MMCM. Peak production figure was 367 MMCM in 1956. Reason for decline in output is attributed to decreasing needs of consumers and not to field potentialities.

Oil and Gas Production in the Netherlands. *World Petrol. 30,* (Sect. II) Holland 4 (1959) June (8 pp.)

Article includes sections on geology and exploration, geophysical exploration, mining act and concessions, and drilling and development. Latter section includes production methods, secondary recovery methods, transportation of crude, gas production, sulfur content of crude or gas, and relations between home consumption and production.

Petroleum Gas and the State Gas Service. *World Petrol. 30,* (Sect. II) Holland 13 (1959) June.

Almost 59% of the total gas production for public supply takes the form of long distance gas, two-fifths of which is supplied by the oil industry. It is anticipated that by the end of 1959, 37% of the total gas needs of the Netherlands will be covered by the oil industry and the same percentage by coke-oven gas, while conventional local production will cover only 26%. Length of the network of the State Gas Service at the end of 1958 was 1116 miles, the gas being transported through seamless pipes of diameters ranging from 4-12-in. Pipes are all electrically welded and have anti-corrosion cathodic protection. The Service sells and delivers gas to 53 municipal gas companies, ten of the largest of these redistributing the natural gas after thermal or catalytic cracking. These companies serve 70 local distributing centers.

Why Sahara Oil Will Have Widespread Impact. W. M. Jablonski. *Petrol. Week. 9,* 16 (1959) July 31 (2 pp.)

First major opening of French Sahara oil production this winter will have far-reaching repercussions on the world oil industry—far beyond the actual supplies involved. It will have a direct and immediate impact on Middle East production and revenues, on Suez Canal traffic, on the pattern of oil trade in Europe, and on the refining and marketing investments of international oil companies in France. In addition, some Sahara crude is almost certain to be shipped to the U.S. and Canada. French Government is determined to see that the crude does get marketed, both in France and overseas—and it is in a position to see that it does. It has ruled that Algerian Sahara crude, which is classified as "national" production, is to have priority in French markets.

Exploration

Amoseas Makes Good Strike in Libya. *Oil Gas J. 57,* 116 (1959) July 27.

Another company has found oil in the intense exploration play in northern Libya. American Overseas Petroleum, Ltd., brought in Beda 1 on Concession 47 with a flow of 1282 bbl/day of 36°-gravity crude from about 4000 ft. The wildcat is near the southern boundary of the 1,024,000-acre block and 264 miles south of Bengasi.

Venezuelan Exploration Slows. *World Petrol. 30,* 47 (1959) July (5 pp.)

Wells drilled for oil and gas in 1958 totaled 1193, about 35% less than the 1828 wells drilled in 1957.

Footage drilled was 8,695,637, or 21.8% less than the 11,125,835 ft of 1957. Average depth in 1958 was 7484 ft vs 6017 ft in 1957. The number of wildcats and outposts drilled varied little from 1957 to 1958, but the number of field wells declined by about half, from 1272 to 616. Article includes detailed table of exploratory wells in Venezuela in 1958, classified by state and operator, with maps showing locations of important exploration wells drilled during the year.

Energy Sources

Petroleum's Place in the Future Energy Requirements of the United States. T. W. Phelps. *J. Petrol. Tech. 11,* 22 (1959) July (4 pp.)

Although total energy requirements are expected to rise from an equivalent of 20.0 million bbl/day of oil in 1957 to 28.5 million bbl/day in 1968, oil's actual contribution is predicted to decline from 44% in 1957 to 43% by 1968. This is an important assumption—one which will cause disagreement. Author discusses economic reasons, emphasizing causes and effects, behind this assumption and points out why it may not necessarily be true.

Solar Energy

Electrical Storage of Solar Energy. H. L. Foote, Jr., R. C. Shair and D. H. Smith. *Mech. Eng. 81,* 41 (1959) July (3 pp.)

Current technical feasibility of methods of storage and their economic aspects have been examined by the authors in order to uncover and develop some of the storage problems that must be solved before a practical electrical power output can be obtained from solar energy. Authors believe that the present methods of constructing electrochemical storage devices will not permit the necessary reduction of cost. It will be necessary to explore new ideas and new methods of constructing storage batteries, to investigate other electrochemical systems such as the primary-battery ones, and to accelerate development of storage systems based on use of the fuel cell.

Solar Water Heating. E. A. Farber. *Air Conditioning, Heating and Ventilating 56,* 53 (1959) July (3 pp.)

Brief description of methods used for solar water heating—the only commercially available application of solar energy in the U.S. at this time. First, present practices are outlined and then, newer and better designs. Solar-heated water has found applications in domestic hot water supply, in restaurants, hot water for space heating and swimming pool heating. A similar method can also be used for air heating and is described at the conclusion of the report.

Heat Pump

100-ton Heat Pump for $3.50 a Sq Ft. J. W. Cook. *Power 103,* 74 (1959) July (2 pp.)

Although the Mississippi River, a seemingly natural heat exchange medium for the heat pump, flows right past the St. Louis Shipbuilding Co.'s new office building, an air source heat pump conditions the structure. Loads for the 30,000 sq ft three-story building total 78 tons cooling, 780,000 Btu/hr heating. Total demand plus energy charge for the nine months ending December 31, 1958, came to $1590.37 for 182,170 kwhr, or $0.873/kwhr. Low electric charge results from heavy welding load plus other equipment working at shipyard, making low cost power available for heat pump operation.

Water Heaters

Demand for Pool Heaters Builds Important New Load for Gas. P. Lady. *Gas Ind. 3,* 22 (1959) Aug. (2 pp.)

In many sections of the U.S. swimming pool heaters are providing an important market for gas. To some extent overlooked by utilities and LPG companies, this outlet is attracting more attention and promises to be a major use for fuel in the future. The 1959 Market Report of a trade magazine reports that approximately 51,200 pools were built in 1958, an increase of 16.4% over 1957. Of these, 37,400 were residential pools. Expectations for 1959 are continued growth and the forecast is for 62,000 new pools. California, the Southeast and Southern states are the major areas in which pools are being built. Average use of a pool heater in southern regions, over a nine-month period, is 30 hr/month. Gas usage is 160,000 Btu/hr.

3. NATURAL GAS AND PETROLEUM MANAGEMENT

Drilling

Diatomaceous Earth Cures Lost Circulation in Cementing Casing. A. J. Willis and R. A. Wynne. *Oil Gas J. 57,* 78 (1959) Aug. 3 (7 pp.)

Strength requirements for cements in casing jobs have been revised downward in the drilling industry lately. As a result lightweight slurries have become acceptable and, moreover, are proving to be a needed solution to the problem of lost circulation while cementing casing. These slurries have better perforating characteristics and, most often, their use is adequate to maintain circulation. Through the use of these slurries, it now is often possible to cement casing in a single stage where two or more stages were necessary before.

Drilling Engineering: Key to Continued Progress. M. M. Brantly. *Drilling 20,* 64 (1959) July (3 pp.)

Out of the fight to cut costs through increased drilling efficiency have come tools and techniques whose adoption or rejection must hinge on application of modern engineering knowledge. Equipment analysis is self-paying and economics is a vital part of tool evaluation. As holes are drilled deeper and equipments and labor costs increase, the necessity for proper engineering from start to finish will increase. Soon drilling engineering will be recognized as an exact science represented by intelligent and well-trained specialists.

Operators in Rockies Drill with Air . . . and Bank the Savings. R. W. Sneed. *Oil Gas J. 57,* 101 (1959) July 20 (3 pp.)

Air has been used to drill in almost every major Rocky Mountain basin; some 1500 wells have been drilled with natural gas in the San Juan basin alone. As a result of their air drilling activities, operators in the Rocky Mountain area have realized big savings in direct well costs through reductions in rig time, in number of bits used and in amount of drilling fluid required. Besides its speed of drilling, and its lower consumption of bits, air drilling has other qualities which are enumerated briefly in the article.

Rotary-Percussion Drilling. *Petrol. Eng. 31,* B-36 (1959) July 15 (2 pp.)

Commercial production model of a new air or gas rotary-percussion drilling tool, developed at Pan American Petroleum's Tulsa research center, has been used in two wells in the Elk Basin field of Wyoming, with penetration rates ranging from two to five times the rates established by conventional rotary air drilling, and with up to four times longer bit life. Test models have also performed successfully in seven other wells in Wyoming, Canada, New Mexico and Utah. New tool can be used in any area that is suitable for air or gas drilling. Penetration rates in excess of 100 ft/hr have been achieved in those areas where adequate weight on the bit could be used.

Slim Hole Drilling Decreases Carter's Development Costs. H. J. Flatt. *J. Petrol. Tech. 11,* 19 (1959) July (3 pp.)

Composite experience of the Carter Oil Co. reveals a significant economic advantage in slim hole drilling practices. Major savings evolve from reductions in daywork and footage rates, lower unit bit costs, improved rig mobility, volumetric reductions in drilling fluid requirements and utilization of smaller casing. To obtain maximum savings, properly sized slim hole equipment should be used.

Exploration

New Discoveries Spur Interest in Wyoming's Green River Basin. T. Dougherty. *World Oil 149,* 85 (1959) July (4 pp.)

Situated in the southwest corner of the state, Green River basin has been the scene of numerous important gas discoveries that include new fields as well as major step-outs and new zones in existing shallower fields. Activity during the first five months of 1959 included 18 wildcat completions—5 gas discoveries, 21 development wells. Increased activity is expected for at least five years. About 20, or one-third of the rigs working in Wyoming, are concentrated in the Green River area. New production is being found at 10,000-15,000 ft, from Mesaverde and Frontier formations. Drilling prices range from $5-$15, depending on the area. Dual completions and separate pool drilling programs are common in the basin.

Geology

Puget Sound Area Has Several Prospective Oil and Gas Basins. J. Q. Anderson. *World Oil 149,* 111 (1959) July (4 pp.)

Green River District near Puget Sound in northwest Washington State has large structures that are favorably comparable to known productive areas in California. Several sedimentary basins occur in the area, and contain large thicknesses of Upper Cretaceous and Tertiary rocks, both marine and nonmarine. Despite many difficulties, known data justify high promise of significant oil and gas reserves.

What Are the Prospects in Washington State? F. H. Wurden. *World Oil 149,* 94 (1959) July (5 pp.)

Ocean City Anticline, a seismic prospect located on the Pacific coast of Washington state, ranks as that state's main oil prospect despite 10 unsuccessful attempts in as many years to develop commercial oil and gas production. All tests drilled on the prospect reported strong shows of oil and gas. Thousands of feet of marine Tertiary sediments, including Eocene, Oligocene, Miocene and Pliocene strata, are prospective in extreme western Washington. Completion problems have been difficult, but may be overcome in the future with profitable results.

Logging

Nuclear Logging in the Appalachian Basin. R. MacFarlane and R. K. Ault. *Producers Monthly 23,* 24 (1959) July (5 pp.)

Single neutron curve is for determination of porosity and delineation of subsurface formations. Data indicate that the gamma ray log can be used for the correction of the neutron response when determining porosity in shaly formations. It is recommended to

run a caliper log with the gamma-neutron combination because of the dependence of neutron response on bore hole diameter. Dual spaced neutron curve is more diagnostic than the single spaced neutron curve when resolving whether the formation of interest is liquid filled or gas filled. In cased and mud filled holes, the short spacing can generally give a fair approximation of the porosity in gas bearing formations. This is because the depth of investigation of the shorter spacing is approximately that of the depth of invasion.

Sonic Log Applications in West Texas and New Mexico. M. E. Curry. *Oil Gas J. 57,* 73 (1959) Aug. 3 (5 pp.)

Acoustic log is a most important contribution in logging technique and great advance may be expected in the near future by better instrumentation, better interpretation techniques and in the presentation of the recorded curve. It is possible to run and record simultaneously curves of two or more spacings at the present time. Desirability of such a log is obvious. However, at present, instrument has some disadvantages, among them: Log must be run in an open hole: it must be run in liquid over the logged interval; variable parameters other than porosity, such as pressure, saturating fluid and many others, slightly affect the log; at the present time, fewer people are familiar with the interpretation of the acoustic log than other types of log. While these disadvantages may be eliminated in time, even in its present form the log is worthy of consideration in any logging program.

Prospecting

Microbes Locate Gas Production in Field Test. R. J. Strawinski and W. B. Cox. *World Oil 149,* 93 (1959) July.

Microbe prospecting is a positive approach to oil prospecting which seeks a more direct indication of oil and/or gas. Technique involves tiny microorganisms, invisible to the eye, which live on hydrocarbon gases which escape to the surface. Method will not always point out the exact location of oil, because the escaping gas on which the microbes feed does not necessarily rise vertically to the surface. However, experience confirms that some oil and/or gas is in the immediate vicinity. Method, when tried on a field scale for the first time in Louisiana, resulted in two producers and two dry holes — as predicted.

Recycling

World's Largest Submarine Gas Line Boosts Lake Maracaibo Conservation. R. B. Leathers. *World Petrol. 30,* 44 (1959) July (3 pp.)

With the completion of a large compression and injection plant in Lake Maracaibo, Venezuela, in late 1958, three such plants were in operation to deliver gas for pressure maintenance of several oil reservoirs in the Tia Juana area of the Bolivar coastal field. Plants will be supplemented by a fourth in late 1960. Four plants, located on pile-supported platforms in 65-100 ft. of water, will have a total intake capacity of almost one billion CF/day of gas. A total of 36 gas-fired turbines will furnish 268,000 hp to drive an equal number of centrifugal compressors to boost the gas from suction pressures of 15-40 psig to discharge pressures of 1800-2500 psig. This entire system of plants is a major endeavor in Creole Petroleum Corp.'s continuing long-range program for conserving and utilizing the gas produced with the oil in the Venezuelan nation. Due to a lack of large industrial and domestic markets for the gas, other means of utilization and conservation had to be sought. By using this associated gas in secondary oil recovery projects, Creole is able to justify the large investments required on the basis of increased oil recovery and at the same time conserve the gas for future markets.

Reservoir Engineering

Effect of Composition and Temperature on Phase Behavior and Depletion Performance of Rich Gas-Condensate Systems. R. H. Jacoby, R. C. Koeller and V. J. Berry, Jr. *J. Petrol. Tech 11,* (TN 2038) 58 (1959) July (6 pp.)

Experimental phase behavior of several field gas condensate systems, one field volatile oil system, and a series of synthetic systems having gas oil ratios from 2000-20,000 SCF/bbl stock tank oil was measured. Data were used to calculate the depletion performance of the field systems at their respective reservoir temperatures and of the synthetic systems at various temperatures. Results of the performance calculations were used to prepare correlations of total stock tank oil and separator gas in place, and the amount of each recovered by primary depletion. Data needed to use the correlations are initial gas oil ratio, initial tank oil gravity, reservoir temperature and reservoir pressure. Correlations presented should be useful for estimating recovery from reservoir producing volatile oils or rich gas condensates having gas oil ratios from about 2000-30,000 SCF/bbl of stock tank oil.

Speed Is Watchword at Wilmington. D. H. Stormont. *Oil Gas J. 57,* 106 (1959) July 27 (2 pp.)

Wilmington (Calif.) operators were charged with not exerting sufficient effort to reach the goal of injecting a million barrels of water/day. The time schedule called for some 400,000 bbl of water to

be injected daily during July. Actually, only about 210,000 bbl were being injected, the same volume which was being handled last January. About 50,000,000 bbl of water has been injected since last October, more than half of the total injected to date. City of Long Beach is rushing the construction of plants which ultimately will supply more than 1,000,000 bbl of ocean water daily. Because of its large interests, the city has assumed the job of supplying water for all projects. A survey of elevations in the harbor area last August for the first time revealed that the program was giving results. The subsidence rate in the vicinity of Pier A had had been reduced.

Secondary Recovery

Progress Report of LPG Injection in the Meadow Creek Unit, Lakota B Reservoir. L. L. Harbert, P. W. Reed, R. K. Bray and J. N. Dew. *J. Petrol. Tech.* 11, 26 (1959) July (4 pp.)

Results of a field test of oil displacement by liquid propane and butane are presented. Since March 1956, an LPG miscible flood project has been in operation in the Lakota B reservoir, a small reservoir of nine wells located in the Sussex area, Johnson County, Wyo. The Lakota in this reservoir consists of two zones separated by a shale break of 10-12 ft. Injection has been in the upper zone only. Average producing depth is 7350 ft and as of July 1958, the average bottom hole pressure at datum (-2120 ft) was 589 psig. Data on GOR, injected volumes and individual well performance are discussed. During the 28-month period the flood was in operation, 275,000 bbl of propane and butane were injected into two wells, and 72,000 bbl of oil were recovered over normal decline. The reservoir was shut-in during July 1958 to build up pressure to obtain miscibility between LPG and gas.

Well Practice

Cut Well Costs with Tubingless Completions. J. E. Willingham. *Drilling 20,* 97 (1959) July (2 pp.)

Results from development operations to date indicate that tubingless completions offer the oil industry an important economic tool for the future. As presently understood, tubingless describes a completion in 2⅞-in. O.D. casing, even though the well may actually be produced through hollow sucker rods, non-upset tubing as large as 1½ in., or without any tubing. These completions in 2⅞-in. casing have evolved from efforts through reducing the needed quantities of steel products. They have been brought about by the same economic factors which led to the "slim hole" (one using casing smaller than 5½ in.) and the still earlier adoption of 5½-in. casing in many instances where 7-in. production strings had been the custom.

Gas-Lifting Through the Annulus of a Well. A. L. Benham and F. H. Poettmann. *Petrol. Eng. 31,* B-25 (1959) July (7 pp.)

Much information concerning gas lift flow through tubing has appeared in the literature. Article analyzes Baxendall's data, using the "equivalent diameter" expression (D_i-D_o) to describe a calculation procedure which will permit the logical design of gas lift installation where the flow is through the annulus between the tubing and casing of the well, and to discuss the characteristic behavior of gas lift installations.

Gilsonite . . . Unique Additive for Oil Well Cements. K. A. Slagle and G. Carter, *Petrol. Eng. 31,* B-32 (1959) July (6 pp.); **Low-Density Cement—Lost-Circulation Slurry—Gilsonite Gives Both.** *Oil Gas J. 57,* 107 (1959), Aug. 10 (7 pp.)

Gilsonite, mineralogically classified as an asphaltite, is a relatively new and unique additive for the oil industry's use to combat lost-circulation conditions. Its properties make it valuable for both heat and electrical insulation applications. Among these are low specific gravity, particle-size distribution, impermeability, resistance to corrosive fluids, chemical inertness and low water requirements. This results in a slurry having exceptional bridging properties, low slurry weight, compatability with other slurry additives and relatively high compressive strength when compared to other slurries of the same weight.

Here's How to Improve Your Gas Lift Installations. Part 1. Pressure at Depth Determinations. H. W. Winkler. *World Oil 149,* 63 (1959) Aug. 1 (5 pp.)

Accurate injection gas pressure at depth calculations are essential for designing and analyzing most gas lift installations. The several recommended procedures for valve design require the injection gas pressure at depth for calculation of gas lift valve depths. In many gas lift installations, the depth of the operating valve can be determined from the surface injection pressure if the injection gas pressure opposite the operating valve can be calculated with reasonable accuracy. Charts and formulas for pressures and compressibility factors are given with examples of application.

Needed: Closer Supervision of Equipment Used for Blowout Prevention. F. L. Walker. *Oil Gas J. 57,* 171 (1959) July 27 (3 pp.)

Further integration among engineering departments, company field representatives, contractors, service companies and manufacturers is needed. Ideally an operator would delegate responsibility and authority for blowout prevention equipment to one individual who would then supervise the equipment from contract negotiations to completion of drilling. Again

ideally, this individual would consult with the manufacturers, service companies and his own drilling department. He would also serve as a liasion man between staff and management. Finally, before the drilling rig moved in, he would draw up specific and detailed requirements for installation and use of all blowout prevention equipment.

Unusual Techniques Solve Wilmington Subsidence Problems. D. Allen. *World Oil 149,* 86 (1959) Aug. 1 (3 pp.)

Drastic innovations in the methods of drilling and casing wells in the subsidence area have proven successful in the Wilmington oil field, Los Angeles County, Calif. Test of time has shown that the use of an enlarged annulus or "bell hole", expansion-compression joints, bell hole packed material and adjustable column supports for well heads are all effective in the prevention of casing damage from subsidence and minor earthquakes.

A Water Shut-Off Method for Sand-Type Porosity in Air Drilling. R. J. Goodwin and A. J. Teplitz. *J. Petrol. Tech. 11,* (T.P. 8070) 163 (1959) July (6 pp.)

New type of water shut-off for use in air drilling has been developed. Method has been 99-100% effective in several different formations of intergranular type porosity. Since costs for materials, time and equipment used are relatively small, the process should extend economies of air drilling to many new areas. Treatment involves a new technique for forming a water-insoluble precipitate within the pores of a rock. Advantage is taken of the difference in mobility of a liquid and a gas in porous media to achieve the greatest volume of precipitate in a given pore. Reactants selected for the laboratory and field tests were aluminum sulfate solution and gaseous ammonia.

Shale Oil Recovery

Apparatus for Recovering Combustible Substances from Subterraneous Deposits In Situ. M. O. Eurenius and B. Persson (assigned of one-half to Svenska Skifferolje Aktiebolaget and one-half to Husky Oil Co.) U.S. 2,890,755 (1959) June 16.

Recovery of valuable products by heating of underground strata is achieved by a tubular combustion chamber, fed by fuel-oxygen mixture, which is lowered into the casing to the level of the underground strata. The position of the combustion zone in the burner is controlled by holding the linear flow of air-fuel mixture just below the linear propagation velocity of the flame. Combustion products from the zone pass upward between the inner burner and well casing to heat the formation outside of the casing.

Apparatus for Recovering Combustible Substances from Subterraneous Deposits In Situ. N. A. Hoffstrom and M. O. Eurenius (assigned of one-half to Svenska Skifferolje Aktiebolaget and one-half to Husky Oil Co.) U.S. 2,890,754 (1959) June 16.

Improved recovery of valuable products from underground deposits is claimed to be effected by a heating apparatus designed to be lowered in the borehole. The heater is composed of a series of multiple annular burners spaced vertically in the formation on a divided central tube which supplies both air and fuel. Each burner assembly may consist of four or more nozzles supplied from below by individual annular drum manifolds for air and fuel.

4. GAS CONDITIONING AND LPG RECOVERY

Carbon Dioxide Removal

A Study of CO_2 and H_2S Absorption Rates, Using Methyl Alcohol in a Counterflow Column at Low Temperatures. L. S. Bezdel and V. P. Teodorovich. *Gazovaya Prom.,* 29 (1959) No. 7 (5 pp. Russian text.)

Absorption rate coefficients were determined on a laboratory scale using a gas mixture comprised of 32% CO_2, 1.8% H_2S, 66.2% H_2, and a column containing glass rings. At 1 atm abs, absorption coefficients for CO_2 were 0.15-0.44 m^2/hr at −30° C, and 0.2-1.1 at −50° C. At 15 atm, these coefficients were 0.13-0.16 m^2/hr at −30°C, and 0.2-1.1 at −50° C. For H_2S, at 1 atm, these values were 2.1-4.1 m^2/hr at −30° C. Absorption of organic sulfur from Leningrad city gas was 71-95% complete in the temperature range −30° to −50° C.

J. W. Penney

Dehydration

What It Costs Pacific Northwest Pipeline to Dehydrate with Calcium Chloride. E. R. Moore and W. G. Cutler. *Oil Gas J. 57,* 166 (1959) July 27 (3 pp.)

In process, gas flows through a series of trays where it comes in contact with brine in various degrees of salt concentration. Brine concentration increases from the bottom tray progressively upward through the five tray levels normally used. Spent brine from the bottom tray falling into the integral-separator section is dumped to a pit for disposal. Gas, while in contact with the brine passing through the trays, has a large percentage of the water removed. From this stage, the partially dehydrated gas flows into the calcium chloride bed where the remaining water is absorbed by the calcium chloride pellets. Weighted average cost of dehydration of $3.00/MMCF, or $.003/MCF compares favorably with similar types

of dehydration operations utilized in the Rocky Mountain area. Cost data are not necessarily applicable to other areas and do not permit comparisons with other types of equipment.

Dust Removal

Gas Cleaners: A Qualitative Analysis. N. W. Wiederhorn and A. W. Doyle. *Am. Gas J. 186,* 33 (1959) Aug. (5 pp.)

Results of A.G.A. Project NFX-12 on performance of gas cleaners discloses interesting data on how various types work, their efficiencies at varying flow rates and some unusual findings. Cleaners described include the oil bath scrubber, centrifugal or cyclone type, and the filter type. Operating principles of each are discussed on an individual basis.

Hydrogen Sulfide Removal

The Alkazid Process for Removing H_2S and CO_2 from Natural or Plant Gas. R. Leuhddemann, G. Noddes and H.-G. Schwartz. *Oil Gas J. 57,* 100 (1959) Aug. 3 (3 pp.)

Alkazid process, originally developed by Baehr and associates, was devised for the removal of H_2S and CO_2 from natural and synthetic gases. Badische Anilin- & Soda-Fabrik AG, of Ludwigshafen am Rhein, introduced the process on a commercial scale to various industries. Process has been developed for the purification of gases and even for the extraction of H_2S from liquid hydrocarbons. Concentrated aqueous solutions of amino acids are used. H_2S and CO_2 can be removed selectively or simultaneously from industrial gases. Corrosion problem is overcome by using the relatively cheaper aluminum (in place of stainless steel formerly used) in reboilers, exchangers, etc. Process has been installed in more than 50 plants including those in Germany, Iran, Sweden, Spain, the Netherlands, Belgium, Switzerland, Italy, Japan, the United Kingdom, South America and Israel.

H_2S to S . . . by Direct Oxidation. H. Grekel. *Oil Gas J. 57,* 75 (1959) July 20 (4 pp.)

Direct catalytic oxidation of H_2S to sulfur in the presence of gaseous paraffin hydrocarbons or other gases has been investigated by the Pan American Petroleum Corp. It was found that H_2S could be selectively oxidized without concurrent oxidation of paraffin hydrocarbons. The process has been proved in bench scale and pilot plant. Economic comparisons indicate that for certain installations the investment for direct oxidation would be approximately 60% of that for the conventional Claus process plants.

Influence of Impurities in Amino-Solution Scrubbing of Lacq Gas. L. Barbouteau. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (6 pp. French text.)

Report does not solve the problem of the influence of impurities in a gas on scrubbing with amino-solutions. One thing is certain, however, and that is that certain bodies contained in the gas tend to cause degradation of the amino-solutions. Available literature on the subject contains contradictory theories. Whole subject is extremely complex and is in constant evolution. The report is confined to outlining the status reached on the problem at the Societe Nationale des Petroles d'Aquitaine (S.N.P.A.) on a comparative basis with available bibliographic data.

New Knowledge and Developments in Dry Sulfur Removal, Especially for the Design of Tower Purifiers. W. Guntermann and F. Schnürer. **Part 1.** *Gas- u. Wasserfach 100,* 594 (1959) June 5 (3 pp. German text); **Part 2.** *Ibid.,* 643 (1959) June 19 (7 pp. German text.)

In spite of the growth of the many chemical cleaning processes for removal of hydrogen sulfide from fuel gases, the dry purification process has actually led the field of H_2S removal and worldwide construction of large plants has continued. Improved features in dry or oxide purification have been added over the years to offset the investment and handling costs and still retain its advantages as a filter bed for tar and dust and in simplicity of operation. Success of operation depends on three factors: 1) Proportion of H_2S before and after the plant; 2) desired build-up of sulfur in the oxide mass, and 3) the number of interconnected purifier units. The influence of these factors is discussed with the aid of graphs. In Part 2, design and construction features are considered, with details on tower systems, layouts, pressure purifiers, ground-level purifiers, handling of charge and plant and operational costs.

Organic Sulfur

The Transformation of Organic Sulfur on Contact with Conventional Drying Products. P. de la Bruniere. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (8 pp. French text.)

Facts proposed are not conclusive but constitute observations made during the course of operations of the units. During the process of drying desulfurized Lacq gas which still contains traces of organic sulfur (mercaptans, COS, etc.), the appearance of hydrogen sulfide can be noted in the gas emerging from the dryers after variable periods of dehydration. The same phenomenon recurs regularly when the same desulfurized gas is subjected to regeneration at 150°-175° C. This phenomenon is more unmistakable in the first stage of desulfurization, when the latter is

carried out with D.E.A., than in the second stage when M.E.A. is employed. Such disturbances probably can be explained by 1) an adsorption/desorption of H_2S during the dehydration process, or 2) a decomposition of the COS and the mercaptans during regeneration.

Carbon Dioxide Removal

Recovery of Gaseous Initial Materials of Chemical Reactions from the Waste Gas. H. Kindler (assigned to Badische Anilin- & Soda-Fabrik AG.) U.S. 2,894,037 (1959) July 7.

Process for recovery of gaseous initial materials from the waste gas of a reactor is claimed in which the several gaseous components (CO_2, ethylene and H_2) of varying solubility in a selective solvent (water) are treated in a two-stage pressure scrubbing operation. In the first stage, the bulk of the most soluble gas is removed and the treated gas, passed to the second stage under higher pressure, is washed with the same solvent and the enriched solvent is added to the first stage, or is separately stripped of ethylene by depressurizing.

Carbon Monoxide

Method of Removing Carbon Monoxide from Gaseous Mixtures Containing Carbon Dioxide Including Measuring the Carbon Dioxide Content Thereof and Actuating Operating Means Responsive to Such Measurement. E. P. Steele and W. D. Southworth (assigned to Phillips Petroleum Co.) U.S. 2,890,930 (1959) June 16.

In a gas purification process, carbon monoxide removal by ammoniacal cuprous chloride solution is improved and its impairment by carbon dioxide is prevented by measuring the carbon dioxide content continuously and adding a controlled amount of ammonia in proportion to increases in carbon dioxide above a predetermined (interfering) amount.

Hydrogen Sulfide Removal

Method of Treating Absorber Solutions Used in Gas Purification. E. J. McCreary (assigned to Phillips Petroleum Co.) U.S. 2,890,931 (1959) June 16.

Regeneration of alkaline absorber solution in a gas purifying system is improved by two-stage heat exchange to raise the solution to not more than 250° F to avoid decomposition of ethanolamine, then contacting the liquid as a spray in a fractionating zone with direct steam at 260°-290° F. Purified ethanolamine is recovered as bottom product and an acid gas stream mixture as overhead. Suction by ejector is maintained on gas offtake condenser and on pure ethanolamine storage zone to remove excess water.

5. NATURAL GAS TRANSMISSION

Automation

How Fully Integrated Control Systems Work. W. F. Haley. *World Oil 149,* 46 (1959) July (6 pp.)

Trend toward centralized system control in the pipeline industry has been prevalent in recent years. There has been much conjecture as to where the trends will lead in the near future. It can be said with certainty that the integrated centralized control system is with us today. It follows that complete automation is the next goal. However, automation as such is a reality today. World's first pushbutton gas pipeline is operating successfully and others will soon follow. Hardware for completely integrating systems operation is available, and a delay in accepting the philosophy of integrated operations will only result in expensive redesign and rebuilding programs later on. Utilizing available equipment and modern philosophies today will ultimately result in reduced operating costs, less maintenance and more efficient pipeline operation.

Microwave: What It Is, What It Does. D. E. York. *Gas Age 124,* 31 (1959) Aug. 6 (3 pp.)

Increased application of computers, centralized billing, supervisory control, telemetering and automatic compressor stations will place greater emphasis on communications. Microwave offers a flexible, dependable tool for furnishing the circuits needed for the automation age.

Compressor Engines

Supervisory Panels Avert Compressor Engine Damage. *Petrol. Eng. 31,* D-31 (1959) July 15 (2 pp.)

Supervisory panel is a multi-handled oiler (or engineer) with a hand continuously on every main bearing in the plant and a finger always at the pulse of all water lines and oil lines. It is a device with a siren voice to warn of trouble. It works by means of safety switches located at critical points on each side of the compressor engines. Switches are activated by rising temperature, except in the case of the lubricating oil system, which depends upon a float to indicate the stoppage of oil flow. Close study and experimentation have resulted in the simple but effective warning systems now in use at Mineola, Magasco, Rodessa, Sarepta and Latex (United Gas Pipe Line Company), with others to follow. In all, 35 of the panels have been built, and when completely installed, they will provide constant supervision of 33,800 hp of compressor station capacity.

Compressor Stations

Remote Control of a Small Booster Station. P. A. Ray. *Gas 35,* 47 (1959) Aug. (9 pp.)

Station discussed was designed and constructed in 1957 by United Cities Gas Co. for its Georgia Gas Co. division at Gainesville, Ga. It is located near the midpoint of the 31-mile transmission line supplying the gas requirements in Gainesville. Natural Gas is purchased from Transcontinental Gas Pipeline Corp. at a tap on its line near Bogart, Ga. Microwave radio was selected as the means of communication between the controlling point (located at the offices of Georgia Gas in Gainesville) and the compressor station. Since this was to be one of the first reciprocating type compressor stations to use full remote control, its design and construction presented many problems as to which functions should be subject to remote control. Control system required to start and stop the gas-fired engine presented no serious problem. Three categories which did require serious study were: 1) Placing the compressor station "on the line" and taking it "off the line"; 2) those functions requiring warning and/or emergency shutdown controls to provide safety and protection essential to station operation, and 3) essential operating data to be transmitted to the remote controlling point. Investment to be made was important item in these considerations.

Fluid Flow

Pipe Line Flow Tests Conducted on 24-Inch Gas Line Near Refugio, Texas. Part 2. C. H. Klohn. *Pipe Line News 31,* 47 (1959) July (8 pp.)

Further discussion on the measurement of variables with charts and equations.

Gas Turbines

1958 Gas Turbine Progress Report. Fuels. A. D. Foster. *J. Eng. Power 81,* 234 (1959) July (10 pp.)

Summary of progress since 1952 with respect to gas turbine fuels is presented together with a review of the operating experiences reported on gaseous, liquid and solid fuels. Technical problems involved are indicated as well as the methods employed for their solution. An appraisal of those areas requiring further developmental study also is included.

Pipeline Construction

Building an Extra High Pressure Line in Mexico. F. V. Long. *Gas 35,* 130 (1959) Aug. (3 pp.)

New gas line to supply Mexico City will originate at Jose Colomo field at Ciudad Pemex, state of Tobasco. Section between Colomo and Minatitlan is now under construction. Initially line will operate up to about 160 MMCF/day without compressors as there will be a pressure off the absorption plant at Colomo field. One of the prime reasons for building this line is to tap a gas source from Colomo field. The existing field at Poza Rica is now at its peak gas delivery volume of 32 MMCF/day. Pipe being used is seamless 0.562-in. thick. It will be stress relieved at the welds. Ten passes would be an average weld condition on this line with the average lengths of tubing from 18-21 ft. It is planned to hydrostatically test this line with water to possibly 7000 psi, but it will not be carried to yield.

Equipment Developments Speed Construction, Better Operations. F. H. Love. *Petrol. Eng. 31,* D-19 (1959) July 15 (4 pp.)

Speed with which a pipeline is constructed means more profits to the contractor, and, because it puts the system into operation sooner, a financial boon to the operating company. To achieve this goal, improvements have been made in almost all types of construction equipment and techniques—ditchers, tractors, pipelayers, welding methods, lineup clamps, etc. Article discusses coatings, line pipe, seismic survey, radar survey, gas turbines, centrifugal compressors, reciprocating compressors, motors, diesels, pumps, tanks, communications and control, metering and batch separation.

How the Mediterranean Can Be Crossed. R. Venet. *Petrol. Eng. 31,* D-3 (1959) July (5 pp.)

Article does not advocate any particular solution to problems involved in laying a Trans-Mediterranean pipeline, but merely discusses them in view of known facts. Long and detailed study must precede any final decision. Current investigations are concerned with two possible routes: The Straits of Gibraltar and along a rough line joining Oran (Algeria) to Cartagena (Spain). Two special ships, the President Theodore Tissier and the Calypso, are engaged in oceanographic studies, prerequisite to the examination of the problems of a more technical nature which will be conducted by research departments, in the laboratory and at sea.

Rules of Thumb for Estimating Pipeline Construction and Operating Costs. P. Reed and G. Kinney. *Oil Gas J. 57,* 95 (1959) July 13 (10 pp.)

From current pipeline experience, certain rule-of-thumb cost estimates have been selected. They cover some of the principal items of materials, equipment, installation, maintenance and operation. In all cases, allowances must be made for local conditions. Tabulated data and examples are given for some petroleum pipeline projects, gas lines, compressor station costs (which vary widely), labor rises (23-29%) and major equipment rises (30.9%). But the conclusion is that pipelines are still the cheapest overland transportation.

Pipeline Operations

Operating Costs of Gas Lines Take Bigger Bite Out of Revenue. P. Reed and G. Kinney. *Oil Gas J. 57,* 93 (1959) July 13 (2 pp.)

Compressor station costs vary considerably from company to company, but they have remained surprisingly stable for the period 1952-57. Average for the 17 companies selected to represent different geographical areas and different types of operation was $25.50/installed horsepower in 1952. The importance of various components shifted during the period but the 1957 average was exactly the same as 1952—$25.50/horsepower.

Pumping Solids Through a Pipeline. J. Nardi. *Chem. Eng. 66,* 119 (1959) July 27 (4 pp.)

Pipeline is more economical than the usual means of bulk transportation, such as barges, railroads, trucks, only when: Large quantities, many years of useful life, high annual load factor and relatively long distances are involved. Cost of preparing slurry for pumping and dewatering it at the terminal often exceeds the cost of transportation. Pipeline transportation does have two basic advantages over other modes: A smaller portion of its operating costs are in labor and materials, both of which are apparently on an upward price trend, and the cost of returning empty containers is eliminated.

6. GAS AND LPG STORAGE

Storage

Hazards Associated with the Storage of LPG. R. B. Jacobs and F. A. Upson. (New York: ASME Annual Meeting, Nov.-Dec., 1958) Paper No. 58-A-151 (7 pp.) $.80 ($.40 to members.)

Petroleum industry has long recognized that certain risks are involved in the storage of liquefied petroleum gases. However, those most commonly considered have been largely those associated with possible ruptures of containing vessels, fires or combinations thereof. The disastrous propane storage vessel explosion at Whiting on January 29, 1957, highlighted a different kind of hazard, namely the possibility of explosive mixtures existing in the vapor spaces of pressure storage containers. Paper is principally concerned with defining the limits of this explosive hazard and discussing the engineering problems associated with it.

Make-Believe Makes Money—Monte Carlo Marine Terminal Model. R. W. Leach. *World Petrol. 30,* 40 (1959) July (4 pp.)

Most economical amount of tankage for a given crude terminal depends upon a number of factors, among which are: Size of the largest tanker being loaded, randomness of the tanker-arrival pattern, amount of control which can be exercised over the size and timing of batches of crude delivered by pipeline, number of different crudes which are being stored and shipped, and the minimum rate of return on invested funds. When everything possible to improve the effectiveness of existing tankage has been done, then one tank at a time can be added until the point is reached at which the addition of one more tank would not be an attractive investment (law of diminishing returns). In some terminals, however, it may be desired to know what the optimum tankage is—not for existing conditions, but for conditions which would exist after making some change being considered. To accurately estimate optimum conditions, Creole Petroleum Corp. engaged the Esso Research and Engineering Co. to make a mathematical model for the former's LaSaline crude terminal on the east shore of Lake Maracaibo in Venezuela. How this complex operation can be represented with numbers can be appreciated by recognizing that in the oil business, numbers are always used to represent almost everything. Such things as volumes of tanks, loading rates, labor costs, and time of tanker arrival can, along with other factors, be expressed numerically.

Tanks

Liquefaction of Ice Stoppages in LPG Tank Cars. A. A. Nalbandyan. *Gazovaya Prom.,* 28 (1958) No. 7 (Russian text.)

Ice stoppages in discharge pipe from LPG tank cars can be removed by forcing 20 l of gasoline or kerosine, heated to 80°-90° C, into the pipe. Equipment includes a steam-heated tank and nitrogen cylinder.

J. W. Penney

Propane Storage Tanks under Reduced Pressure at the Perpignan Gasworks. H. Veillat and A. Helenne. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (51 pp. French text.)

In parallel with a modernization of production means at the Perpignan gasworks entailing the creation of a special room for the catalytic reforming of liquefied hydrocarbons, as well as large storage facilities for propane, experiments were carried out in storing the propane in spheres at lowered pressure. Tanking comprises two spheres of 500 m^3 each, rated at 7 hpz (duty pressure), and two other spheres each of which has a capacity of 100 m^3 and is rated at 16 hpz. The reduction in the spheres' duty pressure makes it possible to diminish the wall thickness, but at the same time requires that they should be covered with a heat-insulating skin to restrict heat exchanges

with the ambient atmosphere to a minimum. Indications are given for determining the thickness of this heat-insulating skin and also about the evolution (predicted and observed) in the internal temperature of these spheres in summer.

Storage-Tank Design Practices to Avoid Brittle Fracture. J. S. Clarke and T. F. Leahey. (New York: ASME Annual Meeting, Nov.-Dec., 1958.) Paper No. 58-A-149 (8 pp.) $.80 ($.40 to members.)

Within the range of service conditions under which steel storage tanks frequently operate, and particularly where atmospheric temperatures are below 50°-60° F, complete failure can occur under applied principal stresses well below generally employed design values. Such failures are much more apt to occur in welded than in riveted tanks, and in large tanks than in small tanks. As a result of two such failures occurring at Fawley, England, within a period of six weeks in 1952, the Esso Research and Engineering Co. carried out a study and experimental program to determine the mechanism of this type of failure and means of preventing similiar failures in the future. Paper presents the design and construction practices for refinery tankage which have been established to avoid brittle fracture.

Underground Storage

Comparison of the Interest of Underground Storage and the Stepping Aside of Industrial Consumers. (Possibility of Grading-Up the Natural Gas Conveyance by means of Underground Storing and by the Aside of Consumers. Compared Costs of the Working Out of these Two Means.) N-Y. Cojan. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (14 pp. French text.)

Maintaining as consistently as possible the demand to the producer and utilizing the conveying network at a high filling rate while insuring the deliveries to final consumers according to the consumption fluctuations which may become more and more marked following the development of heating premises by gas —such are the apparently clashing imperative requirements that the operation of the conveying network of the Lacq gas shall have to meet adequately. With a view to achieving this goal, various technical or contractual means can be utilized, among which two of the most interesting ones from an economical viewpoint seem to be the storing of gas in natural underground tanks or reservoirs and by eliminating (interrupting the gas supply of) some industrial utilizers. Present report is concerned with outlining the possibilites of grading up the conveyance afforded by these two methods and to provide some data about the respective costs of their working out; it describes, should the simultaneous operation of both methods be possible, a way enabling the ascertainment of the top size of the drawing-off plants of an underground tank, taking into account the elimination possibilities. After recalling the data relating to the seasonal sizing-up of the various kinds of consumers, the technical and economical features of the underground storages were considered and, at the same time, a survey of the possibilities relating to elimination of consumers over a set market was outlined. The last part of the report is devoted to the solution of the problem dealing with the previously mentioned top sizing.

Conditions Relating to the Working and Equipment of the Lussagnet Reservoir. E. Clarac and L. Socrate. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (10 pp. French text.)

Underground storage of Lussagnet has been surveyed by the Societe Nationale des Petroles d'Aquitaine (S.N.P.A.) since 1957 with a view to building up a reservoir completing the Lacq plant and the network used for the South-West gas transmission. It was the topic of a statement in 1958 about the prospects of the structure utilization, the carrying out of the first drilling set and of a temporary surface station. Despite the strong heterogeneity of the utilized structure and the looseness of the data provided by the seismic tests, the results supplied by the quick starting into operation of that reservoir, at a 120 Mm^3 level, did not weaken the first computations and estimates foreseeing at the end of 1959 the utilization of a storage of from 400-500MMm^3 of gas with a daily injecting or drawing power of from 4-5 MMm^3.

Underground Storage Facility Boosts Ohio Fuel's Peak Supply. *Gas Age 124,* 26 (1959) July 23 (2 pp.)

Early completion of a new compressor station last fall enabled Ohio Fuel Gas Co. to place some 10½ billion CF of natural gas in underground storage for withdrawal during the past winter. McArthur, Ohio, installation utilizes 90 wells in a 12,000-acre tract for gas storage. This fuel later was transferred, as needed, by company pipelines, to markets in central and northern Ohio to meet customers' requirements.

Underground Storage

Underground Storage System. C. T. Brandt (assigned to Phillips Petroleum Co.) U. S. 2,893,211 (1959) July 7.

In an underground storage system for LPG, in combination, an underground storage cavern, a tunnel connected to said cavern, a pair of spaced fluid-tight barriers in said tunnel forming a seal chamber therein, a volatile liquid stored within said cavern under pressure, a viscous liquid immiscible with and

having a specific gravity greater than the stored liquid occupying the chamber between the two barriers, said latter viscous liquid exerting a pressure against the inner barrier which is greater than the opposing pressure thereon so as to prevent leakage through the tunnel from the cavern, means for admitting and withdrawing liquid from both the cavern and the chamber, and pressure controlling means comprising a conduit having one end connected with the interior of the cavern and the other end connected with the interior of the seal chamber and an intermediate portion thereof positioned above the level of the barriers and external thereto, whereby the two liquids form an interface within said intermediate portion of the conduit, the liquid above the interface being the stored fluid, thereby effecting a small pressure differential between the two liquids.

7. MANUFACTURED GAS AND CHEMICAL PROCESSING

Catalysis

Spray Drying Process Makes Better Catalysts at Lower Costs. *Ind. Gas 38,* (Amer.) 6 (1959) July (2 pp.)

Until recently, Girdler Catalysts plant of the Chemical Products Division of Chemetron Corp., in Louisville, Ky., found it necessary to employ a filtration step, followed by steam dry and granulation processes in the manufacture of water gas shift catalysts. Batch operations were necessary because the material could not be filtered continuously. The colloidal slurry was not compatible with the vacuum filter, yet it was necessary to get fines that could be pressed into tablet form. Installation of a 10-ft. diam. spray dryer in December, 1956, has eliminated three processing steps and by means of this automatically controlled spray drying process time and labor savings have been effected while increasing quality control.

Coal

Coal-Ash Slags. Part II. Flow Properties. J. T. Shaw. *BCURA Monthly Bull. 23,* 169 (1959) May (22 pp.)

Part 1 of this review (see *Gas Abstracts 15,* 194) was concerned principally with the chemistry of the reactions of coal minerals and with the chemistry and mineralogy of the slag obtained as a final product. This part is concerned principally with the flow properties of coal-ash slags and the means by which they are assessed. In the search for efficient means of burning high ash coal for the total gasification of coal, attention has been turned to the slag tap furnace and to the slagging gasifier. Mineral matter in the coal fed to slagging plant may vary widely in quantity and in composition, causing large variations in the flow properties of the slag that is formed. Thus, a demand has arisen for the means of ascertaining the flow properties of slags from different coals in order that variations may be anticipated by, for example, causing flux to be fed into the furnace with a coal which would otherwise give a difficult slag. Assessments of the likely slagging characteristics have been determined from knowledge of one or more of the following: 1) Laboratory measurements of the apparent viscosity of ash samples at plant operating temperatures; 2) chemical composition of the ash from which the slag is formed, and 3) ash fusion determinations, liquidus temperature measurements or such observations as the length of the tongue of slag formed when a ladle of molten ash is emptied down a cold inclined plane, or as the weight of the slag emerging from a short, horizontal cold tube under a fixed initial hydrostatic pressures. Value of these methods is discussed.

Coal Gasification

The Koppers-Totzek Gas Generator in a Chemical Products Plant. A. Macq. *Rev. Gen. du Gaz 81,* 89 (1959) May-June (9 pp. French text.)

Discussion of the specialized problem which the Union Chimique Belge faced in its plant at Zandvoorde and of the work of Dr. Ing. Totzek who invented the gas generator which was put into operation at that plant in October 1957. Some operational results are included.

Fractionation

Computer Control of Internal Reflux in Fractionators. D. E. Lupfer and D. E. Berger. *Oil Gas J. 57,* 68 (1959) Aug. 3 (5 pp.)

Internal reflux computer control system has been successfully applied to a number of fractionators at a cost substantially less than would be required for good reflux temperature control. Tangible benefits from improved column performance appear as sizable reduction in reboiling steam consumption and in more uniform composition of valuable products. Feasibility of computing a difficult-to-measure process variable for purpose of automatic control is clearly demonstrated. Success of simple computer control application has provided an impetus for the application of more complex automatic computer control systems.

Continuous Distillation Plant Controls. R. Parkins. *Chem. Eng. Progress 55,* 60 (1959) July (9 pp.)

Chemical composition is the property which demands a particular distillation process, but in the present state of knowledge, it is not possible to

measure it with sufficient speed and accuracy so that the information can be used continuously in a control system. Therefore, some secondary property such as temperature, which is related to composition, is usually measured. Further complication arises because a distillation unit consists, essentially, of three parts: Reboiler, column and condensing system. For satisfactory process control, these three parts must operate in energy or dynamic balance in the way intended by the designer. When top and bottom products of high purity are required from a single column, the energy balance is the critical factor.

Hydrogen

Hydrogen from Crude for the Air Force. *Petrol. Week 9,* 38 (1959) July 24.

Air Force has just built the world's largest unit near West Palm Beach, Fla., for preparation of liquid hydrogen. Unit uses the Texaco Process. As liquid fuel, it uses, at present, a 25-gravity Sunniland crude, directly from the well. Interesting feature of unit is the catalytic transformation of all the hydrogen to para-hydrogen. The plant—Air Force Plant No. 74—was built and is operated by Air Products, Inc., Allentown, Pa.

Hydrogenation

Studies of Hydrogenation of Ethylene over Copper-Nickel Alloys. W. K. Hall and P. H. Emmett. *J. Phys. Chem. 63,* 1102 (1959) July (9 pp.)

Hydrogenation of ethylene has been studied over a series of copper-nickel alloy catalysts. Activitation energies obtained were relatively constant with composition over most of the range and with pretreatment, indicating that the observed changes in specific activities came about through changes in the frequency factors. No abrupt drop in specific reaction rate near the critical composition of 60 atom % copper was observed. The microcatalytic technique employed was particularly well adapted for the studies of promoting and poisoning effects and allowed the characterization of a large promoting effect of chemisorbed hydrogen on the reaction rate. In the copper-rich range, this effect was so pronounced that these promoted alloys were more active than pure nickel. Relationships between the present work and current theories of catalysts are discussed.

Oil Gas

A Contribution to the Study of Gas Production from Light Distillates. A. Salvadori, P. Lovy and M. Beigelman. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (27 pp. French text.)

Present study is concerned with the gasification of light distillates. This "raw material", storage of which is both easier and less costly than that of liquefied gases, leads to the easy obtainment of a synthesized gas by a cracking and a reforming process using steam on nickel catalyst. Gases belonging to the first family, and those with high calorific values capable of being partly substituted for natural gas, are produced in the presence of alumina. The systematic laboratory tests and the semi-industrial application of the P_9 method, respectively, described in the two sections of the report, have made it possible to define the values of the different parameters affecting the compositions and characteristics of the gases manufactured from such light distillates, and also to determine optimum production conditions for the gases it is sought to obtain.

A Contribution to the Study of Petroleum Oil Cracking. Part 1. Checking on the Cracking Process by Chromatographic Examination of the Gas Produce. Part 2. Selection of Oils in a Thermal Cracking Plant. H. Dumay and B. Coussy. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (38 pp. French text.)

In Part 1, it is pointed out that chromatographic analysis of the gas produced by a cracking plant provides for rapid and accurate calculation of the ratio R= CH_4/total hydrocarbons. This parameter can be used to check operation of any thermal cracking method whatsoever. The ratio R must be held to certain limits that vary with the objective envisaged — optimum efficiency or the obtainment of a given quality of gas or tar. Limits for optimum efficiency are 0.40-0.45. In the same way, it is possible to study the catalytic cracking of heavy oils in the presence of catalysts of the pseudo-dual-function type. A method is suggested for effecting comparisons between catalysts of this family, for appraising their action according to the oil used and for following their progressive vitiation. Part 2 discusses industrial tests carried out at Gennevilliers on a Hall installation. This installation has had a number of modifications carried out, and the functioning principle of such installations is recalled. The tests involved checking the cracking of light and heavy oils by chromatographic examination of the gas produced. Results show that determination of two of the oil characteristics—the index of carburating value and the Conradson carbon—generally suffices to predict efficiencies and production capacities that will be obtained when the oil is used in a Hall installation. It is thus possible to discriminate between available oils. Although the method given is not directly applicable to all thermal cracking installations, there should be no difficulty in suitably adapting it to a given installation.

Oxygen

Investigation of Oxygen Production by Metal Chelates. R. F. Stewart, P. A. Estep and J. J. S. Sebastian. Pittsburgh: *Bur. Mines Info. Circ. 7906,* 1959 (38 pp.)

Key step in changing coals to fluid fuels and chemicals is the conversion of coal to synthesis gas by gasification with steam and oxygen. Cost of oxygen is a vital factor in process economy. At present, most economical method for producing tonnage oxygen is by the conventional rectification of liquefied air. Several alternate methods for producing oxygen from air are: 1) Physical or chemical sorption of oxygen from air by liquids or solids or 2) oxidation of certain inorganic compounds to higher oxides unstable at higher temperature levels. Economic limitations are discussed. Chelated metals of the salcomine type are promising chemical sorbents of oxygen from air. Report covers a study of the reversible sorption of oxygen by salcomine and other chelates. Presence of water in the salcomine structure was verified; it is the loss of this water that causes slow deterioration of salcomine during cycling. Metal chelate process is not economical at this time for producing tonnage oxygen required in coal gasification. However, the salcomine process may possibly be used in small-scale production of oxygen, such as for welding on shipboard, where cost is not a primary consideration. Most favorable conditions for such applications are discussed. Bibliography of abstracted references on the production of oxygen by chemical processes is included.

Peak Load

A 100% Self-Sufficient LPG Peak-Shaving Plant. J. D. Pickard. *Gas Age 124,* 15 (1959) July 23 (4 pp.)

Propane-air peak shaving plant recently completed for the Piedmont Natural Gas Co. at Charlotte, N. C., is unique for its size in that it can be operated completely independent of outside water or electric power supply. New plant incorporates its own water supply for steam boilers and compressor coolant from a nearby well and has its own gas engine driven electric generator which takes over automatically on power failure. A 555 MCF/h standby service is on 30-minute notice. Features include automatic control to 1% of set heating value and Btu range from 1000-1500.

Petrochemicals

Untapped Petrochemical Treasures. *Chem. Week 85,* 39 (1959) Aug. 8 (6 pp.)

Petroleum aromatics of the C_9 and C_{10} groups are being studied by producers and chemical makers, with a show of interest in the polymethyl benzene. Sinclair, Humble, Shell, DuPont, Amoco, Oronite, Minnesota Mining and several others have been working on production and on chemical derivatives. Synthetic processes for mesitylene and durene also are patented. Current use for the C_9 and C_{10} fractions is as a special solvent in automobile enamels. A new large market for derivatives in fibers, films or resin blends would justify building commercial plants for this fraction.

Reformed Gas

Conversion of Integral Gas Lines at Vierzon for Propane Cracking. M. Chouvin. (France: A.T.G. Congress, 1959.) Preprint (Price available from publisher.) (21 pp. French text.)

In 1950-51, the gasworks at Vierzon was equipped with two carburetted complete gasification gas sets (by gas oil/cracking), the rated daily power of each line being of the order of 30-33,000 CM of gas at 4200 kcal/m^3 and efficiency about 1300 CM of gas at 4200 kcal/ton of coal. Experience showed that carburetion with gas oil involved a number of "auxiliary operations" such that a relatively high operating regime had to be adopted for the gas producer. At the same time, the higher the gas producer regime, in theory: 1) The smaller the volume of water gas produced/kg of coal 2) the smaller the number of cal/kg of coal available for its distillation. It was found that a notable improvement in utilization could be obtained by restricting these "auxiliary operations" to the mere production and superheating of the amount of steam needed by the plant. Substituting propane cracking for gas oil carburetion in the gas producer made it possible to eliminate two ancillary pieces of equipment, the carburetor and the fixer. This enabled the gas producer to be operated at a much lower regime since it was no longer subordinated in any way. At the same time, and without departing from the area of interchangeability, it was found possible to incorporate into the manufactured gas, during the blowing stage, a certain percentage of "blown" gas admitted through the predistillation retorts; not only was efficiency improved, but the distillation temperature of the coal was henceforth found to be limited solely to the temperature of the dome of the gas producer. With propane cracking, a set is capable of producing some 60,000 CM/day of gas at 4200 kcal, with an efficiency of 2200-2300 CM of gas/ton of distilled coal. Lastly, an appreciable result is that, without further modification, complete gasification sets converted thus should be capable of cracking not only propane, but natural gas or any other gaseous hydrocarbon equally well.

Installation of a Stein-Roubaix Generator of Cracking Propane in Chambéry and Operation Results. C. Aufauvre, P. Crochon and F. Blanc. (France: A.T.G. Congress, 1959.) Preprint (Price available from publisher.) (12 pp. French text.)

In 1958 the Chambery Works was equipped with a plant designed for the cyclic and catalytic reforming of propane according to the Stein and Roubaix process. This new equipment has enabled the works to increase its peak power and to suppress a set of horizontal ovens, the cost-price of which had become prohibitive. Report describes the installation and discusses the first operational results.

Operation at Lyon of an ONIA-GEGI Cyclic Plant for the Conversion of Propane-Butane Mixtures. C. Jungbluth. (France: A.T.G. Congress, 1959.) Preprint. (Prices available from publisher.) (16 pp. French text.

In order to meet peak loads during the winter, the Lyon-La Mouche Gasworks has, since January 1958, been operating an ONIA-GEGI cyclic cracking plant whose capacity is 70,000 CM/day. This output represents about 15% of the normal production of the gasworks provided by the ovens, Marischka gas generators, blue water-gas plant and a propane plant for cold enrichment of the gas and supply for the cracking process. Propane plant consists of six 100 m^3 tanks in which a mixture of propane and butane is stored, the proportions varying in accordance with deliveries. A butane sphere of 1000 m^3 capacity is at present being constructed. After a description of the cracking plant, the report indicates methods for controlling plant operation in accordance with the composition of the enriched gas mixture supply, and the two faults which must be avoided: Formation of thermal black due to excess of temperature before the catalyzer, and formation of black inside the catalyzer due to insufficient temperature of the latter.

Synthesis Gas

Synthesis Gas Plant at Warren Spring Laboratory. *Chem. & Ind.*, 899 (1959) July 11 (2 pp.)

Synthesis gas plant to provide raw material for research and development work on the Fischer-Tropsch process has been built at the Warren Spring Laboratory. These gas mixtures simulate the type of gas which would be produced by the complete gasification of low-grade coal with oxygen and steam. The hydrogen/carbon monoxide ratio of the gas will be varied to suit the needs of the experimental program. The installation, which cost about £70,000, will have a normal output of 72,000 CF/day, and was designed for a maximum daily output of 120,000 CF.

Adsorption

Purification of Argon. J. W. Armond (assigned to the British Oxygen Co. Ltd.) U. S. 2,893,512 (1959) July 7.

Methane or nitrogen impurities are removed from gaseous argon by adsorption (molecular sieve action) in a bed of dehydrated artificial sodium or calcium aluminosilicates, at low (boiling oxygen) temperatures.

Oil Gas

Method for Catalytic Conversion of Hydrocarbons. C. G. Milbourne (assigned to United Gas Improvement Co.) U.S. 2,893,853 (1959) July 7.

Improved oil gas manufacture is claimed for a cyclic, catalytic, heat and make process in which heating process occurs by downward injection of heavy oil and air into a refractory screen combustion chamber. The combustion gases then are passed upward through a refractory screen in a second refractory-lined vessel. This screen removes ash and aids in complete vaporization of oil at 1300°-1700° F. Beyond the screen is the catalytic (Ni, Co) refractory bed, just below which secondary ash-free fuel oils are injected for added heating (to 1900° F). In the gas making portion of the cycle heavy oil is injected with steam and vaporized as before, and the vapor cracked to oil gas by the catalyst.

Ore Reduction

Apparatus and Method for Heating and Producing Chemical Change in Finely Divided Ores. W. A. Patterson (assigned to Fort Pitt Bridge Works.) U.S. 2,892,698 (1959) June 30.

Finely divided metallic oxide ores are reduced in an improved apparatus, mixed with powdered carbonaceous material which is projected from a feeding chute into a refractory-lined combustion zone in the vicinity of fuel gas or oil flames adjusted to produce a reducing atmosphere. Feed particles fall to the top of a granular bed of ore through which the reducing gases are drawn downward by a suction fan at the base. Reduced ore settles to the outlet of a conical bottom and is withdrawn into a gas-locked chamber for cooling.

Shale Oil

Shale Retorting Apparatus. W. L. Bewley, J. L. Hotz and R. L. Switzer (assigned to Union Oil Co.) U. S. 2,895,885 (1959) July 21.

In a shale upflow retorting apparatus for fines containing solids in which liquids and gases are extracted from a middle disengaging zone, an improved collecting manifold for liquids is claimed comprising a pair of V-shaped troughs extended from around the retort to a lateral point to form a 45°-sloped bot-

tomed settling tank. Vertical baffles aid in holding the settling fine particles, which are removed by screw conveyors running in the bottom of the troughs.

Shale Retorting Apparatus and Process. R. L. Switzer (assigned to Union Oil Co.) U. S. 2,895,884 (1959) July 21.

In a shale retorting method in which granular shale is forced upward by piston and hot gases are forced downward through the shale to a middle annular zone, an improvement is claimed wherein a sloping bottomed annular manifold surrounds the disengaging zone, with its low point connected to a settling tank, and the clear top liquid of the settler is recirculated back through the manifold to flush shale fines therefrom to avoid clogging and to return settled wet fines to the shale feed.

8. GAS DISTRIBUTION

Distribution Systems

After Six Years of Natural Gas, Lawrence Gas Co. Asks 'Where Do We Go from Here?' R. E. Maguire. *Gas 35,* 70 (1959) Aug. (6 pp.)

Advent of natural gas (in Lawrence, Mass.) in 1952 brought a welcome relief to problems of producing and distributing gas. Plant generating facilities assumed a "stand-by" and/or "peak shaving" status. Capacity of company's distribution system was in effect doubled by converting from a 528-Btu gas to a 1000-Btu gas. Success of management's promotional campaigns is evident when it is realized that the Lawrence Gas Co. experienced a 144% increase in thermal sendout for the year 1957 as compared to 1951. Similarly the maximum day thermal sendout for this company increased 279% in 1957 compared with 1951. Author discusses new market being created and company's expansion plans which generally include high pressure for fringe areas, medium pressure for the metropolitan areas and low pressure for the sections adjacent to the gas plant.

Gas Piping Networks in France. P. Courtet. *World Petrol. 30,* (Sect. II) France 43 (1959) June (4 pp.)

Long distance—and hence high-pressure—piping of gas was known to the French gas industry before the war. Industry had familiarized itself with very high pressures (300-400 kg/cm^2) by the use of bottled coal gas for traction purposes. Later, it had to solve the complex problem of transporting coal gas at a pressure of 60 kg, and this in turn led to a highly developed technique in gas processing. Current network, partly complete and partly under construction, will serve to supply France with gas in the following way in the very near future: 1) A large zone including north and eastern France utilizes as its basic gas that derived from the coking plants in the north, the east, the Paris region, Strasbourg, Rouen and Caen; various regions in this zone are provided with very dense piping networks so that very few isolated plants remain. 2) Another large zone is establishing itself around the pipelines conveying natural gas from Lacq which is due to replace the gases currently being produced. Concurrently, this is a zone which is developing lengthwise along the pipelines and which leaves large gaps which are not reached by the natural gas conduits.

Leakage

Evaluation of Current Practices in the Detection, Repair and Prevention of Gas Leaks. G. G. Wilson, D. P. Hogan and G. K. Matus. New York: A.G.A. Operating Section Proceedings; Paper No. DMC-59-32; (1959) Apr. ($.25); **Detection, Repair and Prevention of Gas Leaks . . . An Evaluation of Current Practices.** *Am. Gas J. 186,* 16 (1959) Aug. (13 pp.)

Report of a study conducted by the Institute of Gas Technology under sponsorship of the A.G.A. PAR Plan's Gas Operations Research Committee. Objective of the program was to conduct a penetrating study of the many facets of the leakage problem. Included in the program is a survey of ten companies conducted on a face-to-face basis as well as a thorough literature search (bibliography cites 100 items). Paper discusses nature of the leakage problem, detection and location of gas leakage, leak repairs and prevention of gas leakage. From the study it was determined that the four major areas of research on problems related to leakage of most interest and potential value to the gas utility industry are: 1) Location of the source of a gas leak (pinpointing); 2) repair of leaking bell-and-spigot joints; 3) in-place inspection of pipe conditions, and 4) creation of more economical gas conduits. Future plans on further research on each of these four points are discussed.

Method of Repairing Leaks in Mains Using Joint-by-Joint Internal Treatment. J. Isson. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (10 pp. French text.)

Method described is intended to provide a way of repairing leaks appearing at joints in cast iron or weldless steel mains. This technique makes it possible to effect repairs from inside the mains, operating in sections of 100 meters or so. Apparatus used essentially comprises a detector device which enables the joints to be located and a sealing device of novel form which permits injection into each joint of a

thick polymerizable product which is first stored in a mobile reservoir connected to the sealing unit. Remote transmission of the pressure needed to inject the paste is effected through the medium of a highly fluid liquid, displacement of which is governed from the control point, thus allowing for accurate measurement of the volume of sealing product injected. This method, originally laboratory developed and later perfected in the field on 125 and 150-mm diam mains, should provide a technically and economically valid solution to the problem of repairing leaking pipelines or mains.

New Gas Pipe Repair 'Package' Demonstrated. *Gas 35,* 82 (1959) July (2 pp.)

Emergency gas pipe repair kit that requires no special tools and can be used on nearly all types of mains was recently demonstrated. Kit, which measures 5 by 10 by 13 in. and weighs about 12 lb, contains everything needed to repair almost any kind of leak that gas crews might encounter during a normal day.

In Utrecht, Holland, Alsatian Dog Detects Gas Leaks. J. Grindrod. *Am. Gas J. 186,* 32 (1959) July.

In Utrecht, Holland, an Alsatian dog has been trained to successfully detect gas leaks in the city's gas mains. Of the 795 leaks detected by the dog's keen sniffer during the last six months, 63 were classified as needing speedy repair, 110 were considered as needing repair but not of an urgent nature and 578 were hardly perceptible. A considerable decrease in gas leak detection cost resulted from the new method. Chief expenses were upkeep of the dog and wages for the average 1.5 men, contrasted with conventional methods whose costs included the wages for at least 20 men (five gangs of four men each).

Mains

Tests on Gas Conditioning by Rehumidification and Oil Misting in the Creil Mains Network. P. Asselineau and R. Herve. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (19 pp. French text.)

Gas conditioning tests by oil misting and by rehumidification have been carried out on the Creil mains network. Their object was, first, to test misting apparatus of a specific type and, second, to determine the degree of effectiveness of the conditioning method used. The misting apparatus was of Drouvin manufacture. The device worked very satisfactorily, and the oil mist produced was sufficiently stable to enable the network to be uniformly processed. Effectiveness of the conditioning process was assessed in different ways, but particularly by means of night flow measurements. Thus it was observed that consumers supplied with misted and humidified gas found no increase in leakage, whereas those receiving a dry, nonhumidified gas sustained a marked increase of their leakages. Moreover, a comparison of the behavior of the Creil-Nogent network with that of the neighboring networks showed that humidification avoided rapid decay of seals, but that it needed to be supplemented by yet a further processing using a hydrocarbon base and that in this way misting appeared to give excellent results.

Metering

Measurement of the LP-Gases—1. C. C. Turner. *LP-Gas 19,* 27 (1959) July (10 pp.); **Measurement of the LP-Gases—2.** *Ibid.,* 43 (1959) Aug. (8 pp.)

Three fundamental gas-measuring methods are in common use: 1) Volumetric measurement of liquid; 2) volumetric measurement of vapor, and 3) measurement by weight. No one method is adaptable to all types of gas marketing. Tables of vapor meter correction factors for 0-3500 ft altitude and −40° to 118° F included in the article present a comprehensive summary.

Peak Load

Automatic LPG-Air Peak Shaving Plant Features 'Flame Factor' Btu Control. H. C. Jones. *Am. Gas J. 186,* 38 (1959) Aug. (5 pp.)

Description of new Norwood (Mass.) LPG-air peak shaving plant with background of problem and reasons for selecting this type of equipment. Maximum day quantity of natural gas was 1300 MCF, while the maximum day sendout for the 1958-9 winter was estimated at 1893 MCF. Some peaking or winter service natural gas would have been available, but it was very probable it would not be available on the maximum sendout days. By the winter of 1961-2, it was estimated the maximum day sendout would be 2931 MCF. Economical maximum day quantity take to meet this load was estimated at 1300 MCF, assuming 885 MCF of winter service gas would be available. This would leave 746 MCF to be made. With no winter service gas available on peak sendout days, the 1300 MCF take would have to be increased to 1500 MCF. Without winter service gas, the economical maximum day quantity would be 1903 MCF leaving 1028 MCF to be made. The new LPG-air equipment was designed for 50 psig discharge pressure with a capacity equal to 100 MCF/hr of 1000 Btu gas, on 74.2 MCF/hr of 1350 BTU gas, or 69.2 MCF/hr of 1440 Btu gas. It was estimated that this capacity would cover the peak shaving requirements for about five years. Equipment was selected on basis of economy and ease of maintenance, among other factors.

9. GAS FUEL UTILIZATION AND APPLIANCES

Air Conditioning

Find Air Conditioning Costs Quickly. N. H. Prater and D. W. Antonacci. *Petrol. Refiner 38,* 123 (1959) July (6 pp.)

Article presents charts and design data for rapidly estimating the costs for industrial air conditioning systems.

Houston Bank Building Features Unusual Air Conditioning Center. *Gas Age 124,* 36 (1959) Aug. 6 (2 pp.)

Mechanical equipment for the gas absorption type conditioning system of Houston's Gibraltar Savings and Loan Association is housed in a penthouse. Future plans for expansion provide for the addition of five stories to the present structure. Penthouse then will be completely surrounded by offices. This plan emphasized the need for a system as noise-and-vibration-free as possible. Gas unit was selected because of its comparatively vibrationless system.

Air Pollution

Atmospheric Pollution Control. W. T. Purvance. *Chem. Eng. Progress 55,* 49 (1959) July (5 pp.)

New problem for the steel industry—animal damage from fluorides emanating from a steel plant—required an extensive study beginning with basic determinations of fluoride quantity in materials and waste products. As a result, corrective equipment was recommended and installed. Facility consists of two identical, independent units designed to treat and clean the waste gases emanating from U.S. Steel's Geneva (Utah) mills' two sintering machines. Treating and cleaning processes used in this full-scale application are similar to those studied in the pilot plant work, with the exception of a waste gas recycle principle.

How to Find Fine Particles. N. E. Alexander. *Air Eng. 1,* 43 (1959) July (5 pp.)

Two devices recently have been developed under the guidance of the U.S. Army Chemical Corps which can aid in obtaining information on the size of particles representing air pollutants. First is an optic-electronic instrument known as the "Aerosoloscope" which is capable of counting the number of particles in an aerosol and measuring their size automatically. The other is the membrane filter which is capable of straining out, as a sieve, the particles in an aerosol, retaining the particles on the outside of the upstream surface and allowing the air to pass on through the filter. Particles are deposited in a position favorable for microscopic examination, counting and measurement.

Research Promises . . . Low Cost Cupola Dust Collector. Part 1. L. Silverman and C. E. Billings. *Air Eng. 1,* 40 (1959) July (4 pp.)

Research and development on removal of fine iron oxide aerosols from 1000° F gases reported in article is divided into two phases: 1) Studies of particle agglomeration by thermal, mechanical devices, and 2) use of refractory mineral wool fibers for filtration. Successful filtration of iron oxide particles (open hearth furnace fume) has been accomplished in laboratory and field units, and use of rotary agglomerators improves efficiency and extends filter life.

Burners

General Rules of Operation of Atmospheric Injection Burners. R. Vignes. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (32 pp. French text.)

Objective of study was to check, and sometimes seek, the rules which govern the operation of atmospheric injection burners. In the first part of the report a study is made of existing rules and formulas covering the design, according to classic theory, of the various components of an induction burner. Next, the problems involved with converting a burner for operation with a different type of gas were studied. Factors affecting 1) the suction of primary air for the purpose of increasing the aeration proportion and 2) flame stability, particularly the phenomena of blowout and flashback, were studied. Using the data accumulated, an all-gas burner was designed and constructed. Design characteristics are compared with results obtained experimentally.

Combustion

Combustion in the Heating Industry. *ASHRAE J. 1,* 66 (1959) Aug. (7 pp.)

All-day conference coverng various aspects of combustion was held at ASHRAE Research Laboratory in Cleveland on May 21. Meeting brought together 11 panel speakers, each a specialist in his field, to discuss separate topics of the program. Following these presentations, there was an open discussion of viewpoints by the audience and speakers. Topics included: Burner performance and fuel oil properties; atomization of liquid fuels; mixing of fuels and air; combustion in relation to air pollution; and combustion in the future including catalytic combustion and fuel cells.

Conversion

Combustion and Utilization Characteristics of Manufactured Gas and of Natural Gas. Application to

the Conversion of the Appliances in Use. P. Delbourg. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (24 pp. French text.)

Transformation of appliances utilizing manufactured gas to operation with natural gas is an important problem and of prime concern for Gaz de France. Presentation shows how it is possible to foresee the general priniciples of the transformation of the apparatuses in use. A comparative study of the following main features is included: Theoretical (calorific value, density, theoretical volumes of the air and smokes employed, total carbon, total hydrogen, smoke compositions, inflammability limits, ignition temperature, combustion temperature, flame velocity); and practical (heating output and rate of primary aeration of the burners, flame stability, flame structure and size, flame radiation, dewpoint of the smoke, losses through smoke and yield). Starting from these characteristics, the main elements of the transformation of the apparatuses can be worked out as follows: Change or alteration of the burner injectors (depending on the utilization pressure); modification of the outlet section of the burners; alteration of the combustion chambers (sections of air intake, of combustion products evacuation) of the draught, and consequence of the substitution of natural gas for town gas on some features relating to the operation of the appliances in use.

Converting Industrial Gas Appliances to Natural Gas. J. Melmoux. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (24 pp. French text.)

Possibilities of natural gas are compared with fuels commonly used at present (town gas, liquefied petroleum gases, gas producer gases, coal or fuel oil). First part of the report shows what factors are liable to affect the working of the appliances (flame characteristics, combustion product characteristics). Part 2 deals with the conversion to natural gas of equipment which formerly used another gaseous fuel, particularly town gas—a problem which is foremost in the minds of various Gaz de France departments. Three aspects considered are: 1) The preliminary study, concerned with problems raised by the modifications and which indicates how accessory conditions play a part in these modifications; 2) the technical principles to be observed in effecting conversions and 3) the actual carrying out of the conversions. Consideration is given in succession to modifications to be carried out to atmospheric mixer systems, compressed air systems and compressors; next the burners are dealt with, for which the basic problem is to achieve flame stabilization. Burners are classified into various basic types—banks, blowpipes, torch burners, etc. Report concludes with brief outline of difficulties encountered and solutions adopted in the case of two practical examples of conversions carried out—ceramics furnaces and a small steam producing boiler.

Flame Research

Accelerated Flames and Detonation in Gases. H. Jones. *Proc. Roy. Soc. Lond. (A) 248,* 333 (1958) Nov. (17 pp.) (From *Appl. Mech. Rev. 12,* 497 (1959) July.)

Gas dynamics of an accelerated flame proceeding into a gas initially at rest and starting from the closed end of a tube are discussed from the point of view of a particular accelerated flame model. Flame model assumes that the absolute flame velocity is a fixed fraction of the absolute particle velocity immediately in front of the flame. For two particular cases, one of constant flame acceleration, and the other of a flame acceleration increasing linearly with time, the gas motion and thermodynamic properties, both ahead of and behind the flame, are determined. The location of the point of formation of a shock wave in advance of the flame also is determined. Because of the model assumed, the heat release in the flame front is not constant, but is determined from the solution. A discussion is given concerning the relation of such solutions to the formation of a detonation wave from a flame front in a closed tube. A calculation also is made of the properties of a detonation wave, and it is inferred from comparison with experiment that complete reaction may not always occur in the accelerated flame.

J. A. Fay, USA

Approximate Solutions of Transient and Two-Dimensional Flame Phenomena: Constant-Enthalpy Flames. D. B. Spalding. *Proc. Roy. Soc. Lond. (A) 245,* 352 (1958) June (21 pp.) (From *Appl. Mech. Rev. 12,* 498 (1959) July.)

Paper provides an interesting approximate means of predicting certain transient flame phenomena using the profile methods of boundary-layer theory. Work is restricted to simplified combustion systems occuring under adiabatic conditions, and in all cases it is assumed that the volumetric reaction rate depends only on the temperature. Four types of flame phenomena are examined: 1) The events occuring when a large mass of cold unreacted gas comes in contact with a large mass of hot burnt gas; 2) flame propagation caused by the contact of a solid catalyst "sheet" with a large mass of unburnt gas; 3) flame propagation in a slab of unreacted gas mixture immersed in a much larger mass of hot burnt gas, and 4) flame propagation from a hot pocket of reacted gas im-

mersed in a large mass of cold unreacted fuel/oxidant mixture. This is of particular interest in the spark ignition of gases and in the use of pilot flames to promote combustion in present fuel/oxidant systems. General conclusion appears to be that profile methods provide relatively easy methods of obtaining approximate solutions of certain flame phenomena. Accuracy of this method is stated to be about 20%. A. H. Howland, England

A Burner for Cyanogen Flame Spectroscopy. K. Fuwa, R. E. Thiers and B. L. Vallee. *Anal. Chem. 31,* 1419 (1959) Aug. (3 pp.)

Burner has been designed for cyanogen-oxygen flame spectroscopy. It is simple, sturdy, easy-to-operate and hazard-free. Conventional burners proved unsuitable because of the unusual features demanded by this high temperature flame. Extreme stability and very small volume of aspirated sample solution are prerequisite to the optimal use of this flame in spectrochemistry. New burner provides the needed stability under the required conditions of sample flow rates, and allows accurately controlled introduction of microliters of samples solution per minute. Flame has a much higher excitation energy than can be achieved with previous flame sources. Because of extremely high sensitivity for spectrochemical analysis and excellent analytical precision, the flame produced by the burner is particularly well suited for quantitative flame analysis.

Combustibility of Simulated Automobile Exhaust Gases. B. Greifer and R. Friedman. *Ind. Eng. Chem. 51,* 953 (1959) Aug. (4 pp.)

Feasibility of reducing atmospheric pollutants by using noncatalytic afterburners for automobiles depends on maintenance of a flame in the engine exhaust gases. The flammability of a wide range of synthetic gas mixtures simulating automobile exhaust gases was measured in the laboratory with a flat-flame burner. Equations and a correlation curve relate the combustibility of automobile exhausts to temperature and composition. Results should be of interest to designers of automotive afterburners, to chemical process engineers, safety engineers and others concerned with combustion of vitiated gas mixtures.

Comparative Study of Flame Propagation in Compounds Containing Nitrogen Oxides. S. de Jaegere and A. van Tiggelen. *Combustion and Flame 3,* 187 (1959) June (14 pp.)

Flame propagation velocities and temperatures have been measured in methyl nitrite, nitromethane and methane-nitrogen dioxide mixtures with oxygen. Mixtures of methyl nitrite or methane plus nitrogen dioxide with sufficient oxygen behave like more classical fuel-oxidant mixtures. Activation energies and reaction orders with respect to fuel and oxidant have been derived. Very rich methyl nitrite-oxygen flames are to be compared with pure methyl nitrite decomposition flames; their burning velocities are abnormally low. Nitromethane-oxygen flames are characterized by a low activation, but are much slower than might be expected from the theory.

Detonation Overpressures in Saturated Knallgas-Steam Mixtures. L. B. Adler and J. A. Luker. *Combustion and Flame 3,* 157 (1959) June (11 pp.)

Reflected pressures corresponding to the development of detonation in saturated mixtures of knallgas (stoichiometric mixture of hydrogen and oxygen, $2H_2 + O_2$) and steam at 100° C were measured. The maximum pressure observed was about three times that predicted for theoretical reflected detonation by solution of the Chapman-Jouguet detonation equations and equations for normal shock reflection. Composition limits defining nonreactive and detonatable regions for the particular experimental system employed also were determined. Some considerations applicable to the study of detonation in gaseous mixtures having long detonation stabilization distances are noted, and pressure/time records of different stages of the transition from flame to detonation are shown.

Elementary Treatment of Laminar Flame Propagation. J. O. Hirschfelder, A. McCone, Jr. and T. Odell. Univ. Wis. Dept. Chem., Naval Res. Lab. CM-934 (NOrd 15884, Series 8), 59 pp. (1958) Aug. (From *Appl. Mech. Rev. 12,* 497 (1959) July.)

Basic principles of flame propagation are considered in terms of highly idealized systems. The various factors which determine the flame velocity, v_o, as well as the profiles of temperature and chemical composition through the combustion wave, are explained. S. S. Penner, USA

Hydrocarbon Products from Rich Hydrocarbon Flames. P. H. Kydd. *Combustion and Flame 3,* 133 (1959) June (13 pp.)

New type of burner and gas chromatographic analysis of the products of combustion have been used to investigate the formation and decay of non-equilibrium concentrations of hydrocarbon products in the burnt gases of rich hydrocarbon flames. Evidence indicates that excess concentrations of hydrocarbons arise because those fuel molecules which react first in the flame front are oxidized almost completely, consuming all the available oxygen in the process, and leaving a non-equilibrium fraction of the fuel either unchanged or converted to other hydrocarbons and, in some cases, carbon. These

products are then attacked at a much lower rate by the oxidation products of the burnt fuel, largely water vapor, and equilibrium is approached. Relative rates of primary oxidation of hydrogen, methane, ethane and ethylene have been determined and the rates of disappearance of methane and acetylene, the major unburnt products, have been measured.

On the Length of the Diffusion Flame with Gaseous and Atomized Liquid and Solid Fuels. S. Traustel. *Brennstoff-Warme-Kraft 10,* 367 (1958) Aug. (3 pp. German text.) (From *Appl. Mech. Rev. 12,* 497 (1959) July.)

Analysis is presented of the length of laminar and turbulent flames involving gases and suspensions of liquid or solid particles in gas. Starting point is based upon Schlichting's treatment of boundary flows, and results obtained indicate a linear increase in flame lengths with approach velocity in the laminar region followed by a flame length which is independent of such velocity in the turbulent regime. This behavior is in agreement with experiment. Approach is straightforward and conventional. Inclusion of the treatment of the combustion of drops and solid particles involves a number of supplemental assumptions not usually encountered in such developments.

B. H. Sage and E. Peterli, USA

A Modified Analysis for the Determination of the Burning Velocity of a Gas Mixture in a Spherical Constant Volume Combustion Vessel. K. H. O'Donovan and C. J. Rallis. *Combustion and Flame 3,* 201 (1959) June (14 pp.)

Analysis, based on that of Lewis and von Elbe, is developed to provide a more accurate means of determining the burning velocity of a gas mixture in a spherical constant volume vessel with central ignition. The approach is that of deriving an exact equation for the mass fraction burnt at any instant during combustion, valid throughout the combustion period. This involves a consideration of the temperature distribution in the vessel at any instant. The results given require that experimental records of pressure/time and flame radius/time be taken. The development avoids the possibility of magnification of errors of observation. Analysis proposed permits full use of the chief advantage of the constant volume method, i.e., that the burning velocity may be found over a large range of pressures in a single explosion. An approximate version of the analysis also is given to allow the burning velocity to be determined over the whole combustion range within reasonably close limits, using either a pressure/time or a radius/time record of combustion only.

Optical Flame Structure Studies: Examination of Reaction Rate Laws in Lean Ethylene-Air Flames. A. Levy and F. J. Weinberg. *Combustion and Flame 3,* 229 (1959) June (25 pp.)

Several flat ethylene-air flames have been studied by the 'inclined slit' method under conditions of varying initial temperature and composition. Temperature profiles so deduced together with burning velocities determined by a particle track technique have been used to derive distributions of heat release rate and other relevant parameters. These results are evaluated for their kinetic significance. It is concluded, *inter alia,* that profiles of effective orders and activation energies indicate a varying reaction scheme such that an over-all reaction model, while entirely untenable at lower temperatures, may be of use for the zones near the maximum heat release rate. These zones appear to characterize the behavior of the flame as a whole and their rate laws approach those determining blow-out under highly mixed conditions. Temperature disequilibrium effects are shown to be unimportant for the flames considered.

Radiation from Explosion Flames of Carbon Monoxide. A. S. Leah and H. Watson. *Combustion and Flame 3,* 169 (1959) June (18 pp.)

It has long been known that chemiluminescence occurs in flame gases, but little information regarding its magnitude or importance has been available. The two principal contributions appeared to give conflicting views on the subject. That both sets of authors were justified in their conclusions is now elucidated, and the present work shows that chemiluminescence occurs almost entirely before maximum pressure is developed. Details of the elaborate techniques evolved are presented; the new spherical explosion vessel is described, and the necessary computational procedures indicated. The nature of the latter render progress slow.

Spray Combustion Theory. F. A. Williams. *Combustion and Flame 3,* 215 (1959) June (14 pp.)

Coupled steady-state equations of motion of a statistical ensemble of spherical droplets and a coexisting multicomponent reaction gaseous continuum are derived under the assumption that the induced random fluctuations in the properties of the fluid are negligible. These equations are reduced to a form appropriate for describing the one-dimensional flow of a fluid containing a spray which is stationary with respect to the gas. The burning-rate eigenvalue problem for one-dimensional heterogeneous combustion process of the type $A \rightarrow nB$ is formulated, and an analysis for sprays composed of uniform droplets illustrates the properties of the eigenvalue. An approximate analytical solution for the burning velocity is shown to be in numerical agreement with experiments on tetralin.

Incinerators

How to Install Domestic Incinerators. *Butane-Propane News 21,* 36 (1959) July (3 pp.)

Assuming that the installer has assembled the incinerator itself, according to the manufacturer's directions, the remainder of the installation job can be divided into four parts: Properly locating the incinerator, venting the unit, connecting the gas, and lighting, adjusting and testing. Article describes these steps.

Industrial Heating

Atmospheric Gas-Fired Infrared Heaters for Processing Applications. M. Resek. (New York: ASME Annual Meeting, Nov.-Dec., 1958.) Paper No. 58-A-210 (8 pp.) $.80 ($.40 to members.)

Infrared radiation provides a means for transferring heat from a source to a point where it is needed without heating the intervening air and without any transfer medium. A gas-fired burner operating under atmospheric pressure has been developed as an efficient source of radiation. Heaters having burners of this kind are especially useful for warming buildings of the type frequently utilized for industrial processing. This burner is also employed in the processing field for many other purposes; for example, to thaw frozen cars of coal or ore, to heat dies, molds and cores, to bake finishes, to dry materials, to control humidity or to supply process heat. Some of these uses are illustrated. It is expected that many additional applications for infrared radiation will be found as industries have further experience with this method of heating.

Significance of Waste Heat Recovery Methods to the Gas Industry. J. Bartels, M. Bensky, A. Fox and H. Schoenwetter. (New York: A.G.A. Project ITU-13, June, 1959.) $3.00 (52 pp.)

Steel, copper and cement industries, as major industrial gas consumers, were studied to determine their present level of waste heat utilization both in the U.S. and abroad. There were no recent fresh advances or major developments reported abroad. In general, the heat recovery practices both in the U.S. and in Europe in furnaces of large unit size are as developed as is economically warranted. Most significant result of the investigation is that it has been found that effective waste heat utilization appears to be essentially ignored in furnace sizes of one million to 15 or 20 million Btu/hr. Report points out the type of heat recovery equipment that can be used in this size range, outlines the procedure for designing such equipment, and presents an economic analysis which shows a very favorable rate of return on heat recovery applications for this range of furnace sizes.

Refrigeration

A Primer of Thermoelectric Refrigeration. L. A. Staebler. *ASHRAE J. 1,* 60 (1959) Aug. (6 pp.)

Considering five major aspects of thermoelectric refrigeration, article first presents the advantages of the system. It includes a nontechnical explanation of the thermoelectric process with analogies to well-known principles of mechanical refrigeration. Moving further into the subject, design and manufacturing problems are analyzed. On the basis of these data, suggestions are offered for present and future applications of thermoelectric systems.

Space Heating

Effect of Fuel Composition on Oil Burner Noise. W. A. Beach, R. W. Sage and H. F. Schroeder. *ASHRAE J. 1,* 41 (1959) July (3 pp.)

Sound measurements of the possible oil burner noise sources showed that only the flame contributed significantly to the total noise level. Three noise sources were considered: 1) Background or extraneous noise levels; 2) mechanical noise from the burner and furnace, and 3) the flame itself.

Suppression of Oscillations in Gas-Fired Residential Heating Equipment. C. F. Speich and A. A. Putnam. *ASHRAE J. 1,* 41 (1959) Aug. (5 pp.)

Techniques for the suppression of oscillations in gas-fired heating equipment utilizing burners of both single- and multiple-port type are outlined in simplified form for ready reference. Since the mechanisms of oscillation for each type of burner unit differ, article discusses each type in a separate section. Each section includes a brief summary of the mechanisms of oscillation and outlines in limited detail the techniques that can be applied to suppress oscillations.

Water Heaters

Accuracy of Measurements Made in Tests of Instantaneous Gas Water Heaters. E. Fournel. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (9 pp. French text.)

Important matter concerning the accuracy of measurements made in customary test procedures had only been sporadically touched upon in the past. Through failure to conduct a systematic study of the influence of errors in basic measurements on final results, it was virtually impossible to ascertain precisely what part of the discrepancies noted in the latter was ascribable to faults in the appliances tested and what part to the test procedure adopted. Study discussed determines, with respect to the main parameters involved (useful power, thermal efficiency, combustion index), the upper limit in experimental errors. Since the part played by each basic measurement in the final result is mentioned,

it thus becomes possible for experimenters to assess the incidence of their basic operations and, should an abnormal result be obtained, to seek the possible reasons for the discrepancy noted. It is important in this connection to note the preponderant influence of water temperature measurements. In most laboratories these measurements are obtained with mercury thermometers, and the estimates which follow assume the use of such instruments. Utilization of thermocouples would lead to substantial improvement in accuracy. Evaluations of the most probable error, together with some indications, are included in an appendix to the report.

Burners

Interchangeable Double and Single Gas Burner Structure. E. H. Mueller. U.S. 2,891,608 (1959) June 23.

Dual burner for a range top is claimed which comprises a main burner section so arranged that it can be used as a single burner, and a smaller burner which can be placed in the center of the main burner. When used as a single burner, the central gas mixer chamber is closed by a threaded cap plate.

Burner Control

Thermostatic Control for Gas Burners. R. F. Wiberg and F. J. Silhavy (assigned to Harper-Wyman Co.) U.S. 2,892,349 (1959) June 30.

Thermostatic control for gas burners is claimed which comprises a flat cylindrical capsule filled with a thermostatic fluid which conveys variations in pressure through a spirally-coiled metal capillary tube which connects with a diaphragm valve at the shut-off. Capillary tube is arranged as a flexible spring support to hold the capsule in contact with the cooking vessel's bottom. Capillary spring is shielded by a conical metal sheet, perforated for ventilation and designed to be supported in the center of an annular burner head.

Universal Gas Valve. I. V. Brumbaugh. U. S. 2,893,426 (1959) July 7.

Control valve for burners of cooking ranges is claimed in which improved flame control is obtained by the longitudinal motion of a cuplike sleeve carrying a tapered gas port. This sleeve telescopes into the valve plug and is moved by a screw which rotates with the plug when the burner handle is turned, while the sleeve, loosely keyed to the valve body, cannot rotate. The screw linking the plug and sleeve can be adjusted to increase or reduce the tapered port area for different gases.

Cookers

Stoves and Like Apparatus Using Liquefied Gas. G. F. Corlet (assigned to Soc. d'Application des Gaz, Routiers et Materiaux.) U.S. 2,890,815 (1959) June 16.

For portable devices using liquefied fuel gases such as stoves, cookers, etc., improved attachments are claimed which permit use of easily replaceable fuel cartridges. The cartridge is of flat can type, held gas-tight into a container device by means of a bayonet type plug. The gas inlet heat of the appliance, when screwed into the container top, causes the can to be punctured by a needle thereby releasing the gas to the appliance within protection of the gas-tight annular seal.

10. EQUIPMENT AND INSTRUMENTATION

Computers

How Automatic Computers Aid Process Research. R. C. Cox, L. I. Griffin, Jr. and E. A. McCracken. *Oil Gas J. 57,* 212 (1959) Aug. 17 (6 pp.)

Authors discuss characteristics of analog and digital computers, naming the typical applications of each in process research. Theme of article is that automatic computers help in 1) designing better pilot plants, 2) program planning, 3) data processing, 4) data interpretation and 5) business operations of research organizations.

Corrosion

The Classical Potentiostat: Its Application to the Study of Passivity. N. D. Greene. *Corrosion 15,* 369t (1959) July (4 pp.)

Potentiostat, a device which maintains an electrode at a constant potential, offers a unique means of characterizing the active-passive behavior of metals. Classical potentiostat possesses the desirable combination of low cost, high accuracy, and circuit simplicity. Basic principles of this instrument have been developed and applied to the design of an instrument suitable for electrochemical studies of passivity. A quantitative discussion of the classical potentiostat shows that the total series resistance and the maximum current output completely characterize the performance of this instrument. Its performance can be increased by reducing its total series resistance and maximum current output. Both quantities can be experimentally determined. An improved classical potentiostat with an ultimate potential control of ± 1 mv is described in detail.

Engines

Now—'Horsepower' for Sale. *Am. Gas. J. 186,* 14 (1959) July (2 pp.)

Arizona Public Service has introduced a new concept in the sale of energy. Company is making it easier

for the irrigation farmer by providing 'horsepower' in the form of gas-fueled engines to drive irrigation pumps. Farmer pays only for the 'horsepower' used and the company provides everything else. New type of service to the gas distribution industry is described.

Fractionation

Performance of Packed Distillation Columns. H. Sawistowski and W. Smith. *Ind. Eng. Chem. 51,* 915 (1959) Aug. (4 pp.)

Experimental work has shown that the efficiency of packed distillation columns is low when the mixture undergoing distillation is dilute. Mass transfer theories are unable to account for these results. Relationship between heat and mass transfer in distillation is discussed. It is concluded that it is possible for a part of the total mass transfer to take place by thermal evaporation or condensation.

Heat Exchangers

Calculation of Transients in a Cross-Flow Heat Exchanger. G. M. Dusinberre. *J. Heat Transfer 81,* 61 (1959) Feb. (7 pp.)

Article shows how transient temperatures in a cross-flow heat exchanger may be calculated by numerical methods. Digital computer programming is considered. A gas turbine regenerator is used as an example. In particular, methods are developed which are useful when the flow rates vary, as in the starting transient.

Heat Pumps

Achieving Economy in the Design and Use of Heat Pumps. J. R. Harnish. *Air Conditioning, Heating and Ventilating 56,* 69 (1959) Aug. (12 pp.)

Until recently, the air source heat pump was considered an experimental curiosity; today, it is a recognized method of maintaining year-round comfort conditions in nearly all types of buildings. Through suggested steps in design and operation of the heat pump, it is possible to obtain appreciable savings. Methods of design and operation are considered for various types of systems, with information on air distribution, compression, defrosting methods and controls.

Industrial Heating

The Tunnel Furnace for Bread Making. L. Glachant. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (17 pp. French text.)

Manufacture of French bread requires a special technique which warrants the handicraft form of this trade but hampers the modernization of the bakeries considerably. Gaz de France, with the assistance of the Gouet concern, decided to manufacture and to bring to perfect working a tunnel oven designed for bread making which would be easy to operate and which would be constructed along the lines of modern techniques. This oven features radiant panels (medium temperature) which can achieve a thermic yield of about 70% (based on the net calorific value of the gas). The perfect quality of the product made by this process, the low gas consumption by one metric centner or quintal of flour made into bread, the easy and reliable operation denote this as an equipment which is readily suitable for both the handicraft bakery trade as well as the industrial one.

Utilization of Natural Gas as a Replacement for Fuel Oil to Heat a Glass Tank Furnace. A. de Jerphanion and J. Salmon. (France: A.T.G. Congress, 1959.) Preprint. (Price available from publisher.) (13 pp. French text.)

Discussion of tests carried out in the winter of 1958-59 at the Verreries de Bretagne glassworks at Vertou. Objective was to equip a glass tank furnace for operation using natural gas. After describing the steps taken to effect the switch from fuel oil, report reviews different phases of the tests and analyzes observations made while at the same time advancing certain theories to explain and justify the results obtained. These tests resulted in an entirely satisfactory working regime being obtained with natural gas, both from the standpoint of consumption (which remains comparable with that of fuel oil) and quantitative as well as qualitative production standards. Though it is not possible, without taking certain precautions, to extrapolate these results to other types of furnaces, the conclusions provide most interesting indications for the solution of problems arising in the conversion of glass tank furnaces for natural gas operation.

Piping

Welding Neck Tapered-Face Flanges For Use with Cast Iron Flanged Components. H. H. George and E. C. Rodabaugh. *Pipe Line News 31,* (Annual Directory of Pipelines, 1959-60) 10 (1959) July 15 (8 pp.)

Lightweight, tapered-face, steel flanges were designed to provide an improved mating flange for mechanically connecting steel pipe to American Standard Class 125 cast iron pipe components. Tests, made with these steel flanges bolted to cast iron elbows, included hydrostatic internal pressure, gas internal pressure, internal pressure with superimposed external static bending, cyclic external bending and bolt-up overloading. Comparable data on American Standard 150-lb. steel flanges also was obtained. Tests demonstrated that the tapered-face steel

flanges provide a method of making an improved flanged joint between steel pipe and cast iron piping components.

Steam Generation

CO Boiler Supplements Refinery Steam Supply. H. H. Forgey and T. E. Kobett. *Oil Gas J. 57,* 138 (1959) July 13 (5 pp.)

Production of steam at minimum cost by burning the carbon monoxide and making use of sensible heat in regenerator flue gases was the goal involved in the installation of an additional 250,000 lb/hr of steam-generating capacity. Facility was designed for a generator-gas temperature entering the CO boiler of 1000° F and a flow of CO-bearing flue gas of 422,480 lb/hr. The unit has been in operation since December 1957.

34 CO Boilers Are Now Operating or Building for Fluid or Houdriflow Cats. J. C. Reidel. *Oil Gas J. 57,* 143 (1959) July 13.

Of the 34 CO boilers operating in conjunction with fluid or Hourdriflow cat crackers, or under construction, 27 units are located on the North American Continent with a total steam generating capacity of over 6,000,000 lb/hr. Additional capacity of well over 1,000,000 lb/hr is located elsewhere.

Temperature Measurement

Calibration of Thermocouples to 4000° F. J. C. Lachman. *Instruments and Control Systems 32,* 1030 (1959) July (3 pp.)

Rhenium, which has strength and ductility, was suggested as a replacement for rhodium in platinum-rhodium thermocouples almost 30 years ago, and a limited amount of work has been reported in European literature. Recently, investigations of rhenium have been conducted in the U.S. As a result of this work, rhenium combined with platinum was found to be a promising thermocouple material for limited temperature applications. Furthermore, it was found that rhenium-tungsten or rhenium-molybdenum thermocouples were potentially useful at high temperatures.

A New Technique for Measuring the Spectral Emissivity of Solids at High Temperatures. P. E. Glaser and H. H. Blau, Jr. *J. Heat Transfer 81,* 92 (1959) Feb. (3 pp.)

Principles underlying emissivity measurements in solid materials at temperatures in the range of 3500° K, and conditions for carrying out these measurements are briefly reviewed. Advantages of using an imaging furnace for this application are pointed out and the necessary optical system is described. The function of the shutter for separating emitted and incident radiation, control of the temperature by the aperture-limiting cylinder and the calibration of a spectrometer by a black-body reference standard are explained.

Valves

Small Valves for Instrumentation. D. Salmon. *Instruments and Control Systems 32,* 1026 (1959) July (2 pp.)

Small valves are those in sizes from ⅛-in. to 1-in. pipe. Types include stop cock, plug, toggle, gate, globe, needle, needle globe, pressure reducing, straight and angle. Neglect of small valves may result in system leaks, frozen stems, insufficient flow capacity, poor throttling, etc. Article presents basic application and selection factors.

Valves for Little Flows. R. Horton. *Instruments and Control Systems 32,* 1024 (1959) July (2 pp.)

Small-volume systems are common in pilot and semi-commercial plants. If such systems are to simulate a future process, accurate data on behavior and production results require duplication in miniature; only the volume of throughput is different. Control valves in such a pilot system should be small. A second important application for little valves is in introducing additives in bulk processing. Most of today's products are complex compounds. Injected someplace along the process is a slight inhibitor, a synthetic, a coloring. Such small quantities must be metered into the process with precise control. Article discusses application factors of valves with C_v from 3 down to 0.00006.

11. MATERIALS OF CONSTRUCTION, AND CORROSION

Cathodic Protection

Automation in Cathodic Protection . . . Using Pipelines for Data Transmission. R. Girotti, F. Salimbeni, R. Righetti and A. Giani. *Oil Gas J. 57,* 72 (1959) July 20 (4 pp.)

Unique system is operating successfully on short lines in Italy. Technique has long been considered in U.S. and some experiments have been conducted. Line attenuation is a drawback which limits application to short distance unless equipment is provided to overcome the problem.

Comparisons of Wagner's Analysis of Cathodic Protection with Operating Data for Ships. J. H. Greenblatt. *Corrosion 15,* 339t (1959) July (2 pp.)

Predicted values of the key parameters in Wagner's analytical expression for the conditions for cathodic protection are compared with values found empirically from operating experience in the protection of

ships. Agreement is good over certain ranges of the key parameters. Discrepancies in values and possible reasons for their occurrence are discussed.

Economics of Cathodic Protection. N. K. Senatoroff. *Oil Jas J. 57,* 107 (1959) July 20 (3 pp.)

In July 1958, Pacific Lighting Gas Supply Co. had completed construction of the 34-in. O.D. Grade X-52 transmission line between Taft, in Kern County, and Newhall, Calif. The economical study of the two alternative corrosion protection systems at the outset substantiated engineering recommendations: Use good coating over the entire line; do not provide for corrosion allowance in the form of an extra wall thickness; install contact points (electrical test points) at the time of line construction; design cathodic protection stations, and apply cathodic protection at as early a date as possible.

Coatings

Use of Plastics and Synthetic Elastomers for Underground Coatings. E. G. Partridge. *Corrosion 15,* 101 (1959) July (3 pp.)

Traditional coatings of coal tar or asphalt and combinations of coal tar with epoxy resin are discussed. Application problems are given briefly. Polyvinyl chloride and polytethylene tapes—their characteristics and service as underground coatings—are presented. New materials that have characteristics which make them usable as underground coatings are given with their physical properties, resistance characteristics and costs. Included are neoprene, chlorosulphonated polyethylene, butyl rubber, polysulfide elastomers, butoxy resins, fluorine containing polymers and silicone rubbers.

Corrosion

Corrosion Control at Grand Isle. A. E. Hiller. *Petrol. Eng. 31,* B-41 (1959) July (4 pp.)

Freeport Sulphur Company is constructing the world's largest steel island off the coast of Louisiana. The structure will be composed of five large and ten smaller steel towers, connected by 200-ft long bridge spans. This will support the complex and heavy facilities required by the Frasch process whereby sulfur is melted in the underground formation by superheated water and brought to the surface by compressed air. Steel used in the piling and other members of the structure is not in itself resistant to the corrosion of the sea water or the salt air environment. There are three different corrosion environments which must be guarded against: Totally submerged zone, the splash zone which lies immediately above, and the salt air zone.

Corrosion of Reinforcing Steel in Concrete in Marine Atmospheres. D. A. Lewis and W. J. Copenhagen. *Corrosion 15,* 382t (1959) July (7 pp.)

Where a reinforced concrete structure is exposed to a marine atmosphere, serious corrosion of the reinforcing steel sometimes occurs within a relatively short time and the concrete cover around the reinforcing is spalled. This phenomenon constitutes a major problem in South Africa, particularly in coastal areas. The reaction proceeds by electrochemical mechanisms whose emf's derive from differences in *p*H, aeration or other factors but whose severity is influenced mainly by presence of sodium chloride in the concrete. Accelerated corrosion tests in a salt spray cabinet using steel reinforced mortar specimens indicated that factors of considerable significance are cover to the steel, the curing, cement content and water cement ratio of the mortar. The effects of these variables in steel corrosion are discussed. A comprehensive series of both accelerated and natural exposures of reinforced concrete specimens in progress is outlined.

How External Casing Corrosion Is Being Controlled in East Texas. M. J. Olive. *World Oil 149,* 101 (1959) July (5 pp.)

Operators have found cathodic protection to be the most practical and economical solution to the serious problems of external casing corrosion in the East Texas field. Casing corrosion to date has cost more than $3 million in the field even though most leaks occur at relatively shallow depths (0-500 ft) and are repaired at an average cost of $2500 each. Rectifiers generally are used as the means of applying the required minimum 2 amps current to each well. Both multiple and single well installations have been used and more than 450 wells are now protected by this method.

Porous Ceramic: Unique Filter Medium. *Chem. Engr. 66,* 158 (1959) Aug. 10 (3 pp.)

Specially designed porous ceramic is invading an area of filtration now dominated by porous metals. Intended primarily for high temperature, corrosion-resistant filtration, these new ceramic materials can take temperatures of 1800° F and differential pressures in excess of 600 psig. This material can stand up to most acids, but not to hot alkalis or hydrofluoric acid. A rating of 50 microns means 98% of material larger than 50 will be held back.

Inhibitors

The Inhibition of the Corrosion of Iron in Neutral and Alkaline Solutions. I. P. Hancock and J. E. O. Mayne. *J. Appl. Chem. 9,* 345 (1959) July (8 pp.)

Potentials at which iron is converted into anhydrous cubic oxide in certain inhibitive solutions have been measured and it has been shown that these potentials are more negative than the potentials acquired by unpolarized specimens immersed in the solu-

tions for three days. It is suggested that when iron, carrying its air-formed film, is placed in an inhibitive solution, saturated with air, the corrosion current is concentrated at the weak spots in the oxide film and at these points the potential is consequently raised to that at which anhydrous cubic oxide is produced. The air-formed film is thereby thickened and corrosion prevented. When the *p*H of the inhibitive solution exceeds 9, anhydrous cubic oxide also may be formed by the interaction of the anodic product, ferrous hydroxide, with atmospheric oxygen. This explanation of inhibition has been extended to account for the corrosive nature of pure water, the effect of the concentration of the inhibitor, the dual role of oxygen and the effect of oxygen on the efficiency of non-oxidizing inhibitors.

Coatings

Pipe Lining Apparatus. A. J. Perkins (assigned to Perkins Pipe Linings, Inc.) U.S. 2,892,444 (1959) June 30.

Improved machine for applying coating materials to inner walls of pipelines is claimed, to operate in pipelines of less than 18-in. diam. A hollow-shaft electric motor mounted annularly around the coating feed pipe provides power for traction and for the coating distributor. Hook-like teeth on the traction wheels are designed to hold the machine rigidly in position while coating material is pumped through hose lines and spread on pipe walls by the distributor.

12. ANALYTICAL METHODS AND TESTS

Analytical Instruments

Continuous R.v.p. Analyzer Cuts Gasoline Blending Time in Half. W. R. Foster and P. H. Richer. *Oil Gas J. 57,* 82 (1959) July 20 (3 pp.)

Refiners, in making certain they do not exceed the specifications, frequently ship motor gasoline somewhat below the maximum vapor pressure. Records of one refinery showed that approximately 12% of its shipments were below the maximum Reid vapor pressure by 0.3-0.4 psi. Getting this percentage into the 0.1-0.2 range would provide a good payout for a stream analyzer. To achieve this, a Reid-vapor-pressure analyzer was installed. In addition to obtaining the prescribed objective, it provided better product control, savings in tankage and manpower, eliminated the need for reworking blends and reduced laboratory tests by 1½/blend or over 100/month.

Chromatography

The Comparison of Detectors for Gas Chromatography. I. G. McWilliam. *J. Appl. Chem. 9,* 379 (1959) July (10 pp.)

Properties of gas chromatography detectors are considered under the main headings 1) detector sensitivity, 2) response time, 3) relationship of detector output to molecular parameters and 4) ease of construction and operation of the detectors. In particular, the use of gas concentration units (μg/ml) for the specification of detector sensitivity is advocated. Detector response time is considered in some detail because of its importance for work with high efficiency gas chromatography columns, and the detector properties which are of importance for qualitative and quantitative analysis are discussed.

Gas Chromatography Applied to the Analysis of Phenols. J. S. Fitzgerald. *Australian J. Appl. Sci. 10,* 169 (1959) June (19 pp.)

Phenolic mixtures may be particularly separated by gas chromatography either on polar or nonpolar stationary phases, different grouping of the phenols being obtained on the two types. For more complete resolution of mixtures both types of phase should be used. "Apiezon-L" grease and sodium dodecylbenzene sulfonate were among the most useful materials examined, the second being used in the form of a spray-dried mixture with sodium sulfate which was available as an industrial detergent. Methylation of alkyl substituted phenols prior to chromatography is disadvantageous, although like treatment of chlorinated or dihydric phenols may be helpful. Both these latter groups can be partially separated by gas chromatography on a limited number of liquid phases.

Gas-Liquid Partition Chromatography of Sulfur Compounds with Beta, Beta'-Iminodipropionitrile. J. H. Karchmer. *Anal. Chem. 31,* 1377 (1959) Aug. (3 pp.)

Gas-liquid partition characteristics of 11 sulfur compounds in the 58°-126° C boiling range have been investigated using a column of β, β'-iminodipropionitrile on Celite. At 84° C and a helium flow rate of 70 ml/min, this material resolves compounds on the basis of their electrophilic character. A log-log plot of the retention volumes obtained with the column against the retention volumes obtained with a volatility delineating column (such as white oil on Celite) produced a series of straight lines corresponding to tertiary mercaptans, primary isomercaptans, primary normal mercaptans, aromatics and thiophenes.

In-Process Gas Chromatography. E. E. Escher. *Chem. Eng. 66,* 113 (1959) July 27 (6 pp.)

Process chromatograph repeats the same analysis month after month. It is in the hands of operators who may be unskilled in instrumentation. A high on-stream factor, stability and repeatability of calibration are most important. Every detail, from operation and maintenance to presentation of data, must be as simple and foolproof as possible. In spite of its simplicity, the chromatograph is probably applicable to as wide a range of problems as any analytical instrument. In petroleum these include everything from pilot plants through the refinery plus most chemical and petrochemical operations. Main criterion for determining whether to install a chromatograph for a given plant is how much it can make or save for that plant. Process chromatograph costs about $5000 with its recorder. On first reports, process chromatograph seems to have scored well on both payout and operating costs. Chromatograph has plenty to do in the field it has already conquered. Market research experts of the instrument companies believe that present markets are far from saturated. New developments such as direct control offer the possibility of extention of applicability.

Density

A New Design of the Martin and James Gas Density Meter. K. E. Murray. *Australian J. Appl. Sci. 10,* 156 (1959) June (14 pp.)

New design of the Martin and James gas density meter is described. Gas circuits, arranged symmetrically are of stainless steel tubing. The separate thermocouples of nickel-chrome and constantan are firmly mounted and easily removable from the anemometer block. The meter is electrically heated separately from the columns to allow for its use for programmed heating. Noise level is low and base line stability high. Limit of detection is 0.01 μg/ml of pentane in N_2. Meter has a wide linear range of response with change in density. Nonlinear behavior under certain extreme conditions is explained by the spilling over of gas from the working circuit into the reference circuit.

Gas Analysis

The Effect of Probe Shape on the Accuracy of Sampling Flue Gases for Dust Content. A. B. Whiteley and L. E. Reed. *J. Inst. Fuel. 32,* 316 (1959) July (5 pp.)

Tests have been conducted to develop probes for dust sampling that would be more robust and compact than those normally employed. Several probes of different shapes were tested and of these two "non-standard" types were considered sufficiently promising to warrant further investigation. These were tested over a wide range of sampling velocities using a relatively coarse test dust and their performance was compared with that of the "standard probe" under comparable conditions. It was found in all cases that the weight of dust collected by the probes was almost independent of the sampling rate.

Hydrocarbons

New Method of Hydrocarbon Structural Group Analysis. D. S. Montgomery and M. L. Boyd. *Anal. Chem. 31,* 1290 (1959) Aug. (9 pp.)

Method of hydrocarbon structural group analysis is developed for pure compounds. Three chemical and two physicial properties are expressed in terms of five structural groups in a form which may be simultaneously solved by modern high speed computing equipment. Chemical properties include the carbon and hydrogen content as well as the number of aromatic carbon atoms present per molecule. Physical properties required for the analysis are the molar volume and molar refraction. This method has been tested on a selected group of 114 hydrocarbons whose properties have been determined by API Project 42. Results of the application of this structural analysis system are described in detail and the accuracies attained are tabulated.

Moisture

Charts of the Equilibrium Moisture Content of Natural Gases. Supplement to Inst. Gas Tech. Res. Bull. No. 8 and ASTM Method D 1142-58. (Chicago: Inst. Gas Tech., July, 1959.) $2.50 (16 pp.)

Charts present in convenient graphical form the data in Table C of "Equilibrium Moisture Content of Natural Gases," Institute of Gas Technology Research Bulletin No. 8, and the identical Table III of "Standard Method of Test for Water Vapor Content of Gaseous Fuels by Measurement of Dew-Point Temperature," ASTM Designation: D 1142-58.

Psychrometric Charts Past and Present. D. D. Wile. *ASHRAE J. 1,* 73 (1959) Aug. (7 pp.)

Any review of psychrometric charts must naturally lead to some conclusions and possibly some preferences regarding their general arrangement and structure. Article discusses several of the more popular types of psychrometric charts in the light of their present usage and historical background. Thermodynamic principles are included only as they affect the graphical form, since this phase has been liberally treated by many other investigators. Comprehensive discussion of the history of the psychrometric chart is the author's considered expression of opinion regarding some basic and some derived factors.

Spectrography

The Longest Wavelength Band in the Electronic Spectra of Polycylic Arotmatic Hydrocarbons for Analytical Use. C. Karr Jr. *Appl. Spectroscopy 13,* 40 (1959) No. 2 (6 pp.)

Continuation of the table of electronic spectral data for polycyclic aromatic hydrocarbons (see *Gas Abstracts 15,* 210). Bibliography of 143 items is cited.

Surface Areas

Modification of the Innes Equation for Determining Surface Areas of Low-Area Solids. L. Bini and R. L. Disch, Jr. *Anal. Chem. 31,* 1404 (1959) Aug. (2 pp.)

More general equation is formulated and used in the present determinations for calculating the dead space correction by the rapid, automatic gas adsorption method of Innes. Surface area data for a variety of materials, using the new procedure for calculating dead space, are compared with the data obtained by the conventional but slower, manual, volumetric Brunauer-Emmett-Teller method.

Temperature Measurement

On a Thermometer with Recovery Factor *r* 1. J. A. Rietdijk and A. Valstar. *Appl. Sci. Res. (a) 7,* 251 (1958) No. 4 (5 pp.) (From *Appl. Mech. Rev. 12,* 563 (1959) Aug.)

When a bare thermometer is inserted in a high-speed gas flow, it reaches an equilibrium temperature which is between the static and stagnation temperatures of the stream. Difference is described by a recovery factor $r = (T_m - T)/(T_o - T)$, where T_m is the measured temperature, and T_o and T are, respectively, the stagnation and static temperatures of the stream. Ideally, the recovery factor should be one, i.e., the measured temperature should correspond to stagnation temperature. Practically, recovery factors of the order of 0.8-0.99 may be obtained, depending upon the precautions taken in designing the probe. Authors have designed a probe in which recovery factors greater than one have been measured. This is accomplished by heat transfer from part of the stream whose stagnation and static temperatures are nearly equal to another part moving at high velocity and having correspondingly lower static temperature. The two gas streams run in counterflow and in direct contact with each other within the body of a specially designed probe. Values of r of 1.01-1.04 are reported for the Mach number range 0.75-2.5.

E. L. Foster, USA

Water

Water Determination in "Freon-22" Refrigerant by Infrared Spectrophotometry. W. J. Diamond. *Appl. Spectroscopy 13,* 77 (1959) No. 3 (2 pp.)

Modification of Benning's infrared method permits determination of the quantity of water in Freon 22 refrigerant. The Freon 22 is diluted with Freon 12 refrigerant of known moisture content and the apparent moisture concentration determined by measuring the absorption of 2.67 radiation. From previously determined empirical data, the water equivalent value of the Freon 22 can be determined. Subtraction of the water equivalent value of the Freon 22 and the known water content of the diluent from the apparent moisture concentration is then the moisture concentration of the Freon 22.

Gas Sampling

Systems for Obtaining Gas Samples for Analysis. H. A. Kraftson and E. M. Yard (assigned to Leeds and Northrup Co.) U. S. 2,895,335 (1959) July 21.

Gas sampling apparatus for producing a solid-free stream of gas from a dust and corrosive material ladened atmosphere is comprised of a gas sampling line having an inlet disposed within the atmosphere. Line includes a steam ejector, means for thoroughly mixing the gaseous stream with steam from the ejector, and a means located downstream of the ejector for directing a stream of condensing water into the steam mixture. Ejector aspirates from a dirty atmosphere a sample of the gas to be cleaned and analyzed. Sample of gas is combined with the steam to form an intimate mixture and the mixture is driven through the gas line by pressures produced at the ejector. Adequate amounts of water are added to dilute any corrosive liquids formed by combination of the steam condensate with corrosive materials to prevent corrosion of the sampling system. Temperature of the condensate mixture and water is controlled to minimize the addition or removal of the gas components to be analyzed. Gas to be analyzed then is separated from the rest of the mixture and the clean, solid-free gas sample is conducted to a suitable analyzer.

13. BASIC SCIENCE

Adsorption

Adsorption of Inert Gases by Modified Carbons. W. F. Wolff and P. Hill. *J. Phys. Chem. 63,* 1161 (1959) July (4 pp.)

Adsorption of nitrogen and argon by modified active carbons has been studied by a simple desorption technique. Active carbons modified by the desorption of lithium and various inorganic compounds behave normally; the amount of gas adsorbed at ordinary temperatures and pressures decreases linearly as a function of the amount of modifier. Sodium and potassium cause the development of an unexpected maximum in the adsorption capacity.

This anomalous behavior appears to be associated with the formation of new pores.

Molecular Sieves—The New Refinery Tool. P. W. Sherwood. *Petrol. 22,* 245 (1959) July (4 pp.)

Molecular sieves are a series of adsorbents composed of crystalline sodium and calcium aluminosilicates which have been heated to remove their water of hydration. These materials are unique in that their pores are of molecular dimensions which may be controlled accurately within a small range. These pores will retain molecules smaller than their own diameter, but they will reject large molecules so that an actual screening effect is obtained. Author discusses molecular sieves applied to removal of impurities from ethylene, separation of hydrocarbons by type and removal of sulfur compounds.

Carbon

The Oxidation of Carbon with Atomic Oxygen. J. D. Blackwood and F. K. McTaggart. *Australian J. Chem. 12,* 114 (1959) May (8 pp.)

Atomic oxygen, produced by dissociation of molecular oxygen in a radio frequency field, will react with amorphous or graphitic carbon at room temperatures and both carbon monoxide and carbon dioxide appear in the product gases. Carbon monoxide appears to be the primary product of oxidation of carbon, the carbon dioxide being produced by direct combination of carbon monoxide with oxygen which takes place mainly at the carbon surface. Atomic oxygen will also react with carbon dioxide to produce carbon monoxide and molecular oxygen but the quantity of carbon monoxide produced by this reaction is small compared to that produced by direct oxidation of the carbon.

Carbon Dioxide

Spectral Emissivity of Carbon Dioxide from 1800-2500 cm^{-1}. G. N. Plass. *J. Optical Soc. Am. 49,* 821 (1959) Aug. (8 pp.)

Spectral emissivity of carbon dioxide from 1800-2500 cm^{-1} is calculated as a function of temperature, pressure and amount of radiating gas. Careful consideration is given to the choice of a proper model to represent the emission when the overlapping of the spectral lines is taken into account. At elevated temperatures the random Elsasser model should be used since many vibrational bands overlap. Emissivities were calculated from the usual intensity and energy expressions on an electronic computer taking into account up to 890,000 spectral lines at 2400° K. The electric moment matrix element was evaluated by using the harmonic oscillator approximation to represent the vibrational states. The emission from $C^{13}O_2$ and from the transitions near 2100 and 1900 cm^{-1} was included in the calculation. The shift of the emission to lower frequencies as the temperature increases is quantitatively explained. The emission in this frequency region from any flame can readily be obtained from the results in the article.

Compressibility

New Factor Permits Z Factor Determination in a Digital Computer. E. H. Gray and H. L. Sims. *Oil Gas J. 57,* 80 (1959) July 20 (2 pp.)

Interpolation method requires only 400 entries for the computer to be able to reproduce the original full-size table with accuracy. Key to the high accuracy obtained with relatively small table (20 by 20 table of compressibility factors) is in the selection of the values of P_r (pseudoreduced pressure) to be used for the condensed table. Thus, in the region of maximum inflection of the chart the points are closely spaced and in the relatively linear regions the points are widely spaced. The selected values of T_r (pseudoreduced temperature) and P_r and the corresponding values of Z are tabulated in the article. Method can reproduce compressibility factors with an accuracy satisfactory for most natural gas engineering calculations, and should be applicable to any table or chart of natural gas compressibility factors.

Fluid Flow

Beware Sonic Flow. W. A. Rostafinski. *Chem. Eng. 66,* 129 (1959) July 27 (5 pp.)

All materials — solid, liquid or gaseous — transmit sound waves. Under certain physical conditions, the velocity of these waves becomes highly significant. Many fluid flow problems, including those pertaining to liquids, require knowledge of speed of sound waves propagated in the fluid. Other applications, especially those concerning gases, require the determination of the state of the fluid in terms of its thermal and kinetic energies.

How to Handle Unusual Flow. J. Coates and B. S. Pressburg. *Chem. Eng. 66,* 131 (1959) Aug. 10 (6 pp.)

Flow of compressible fluids and flow in complex piping and piping networks require methods of analysis which differ from liquid flow in circular conduits. For noncircular conduits the same relations as for circular conduits may be used providing an equivalent diameter is defined. In piping networks consisting of the same or different pipe sizes connected in series or parallel or both, methods must be derived to calculate total resistance to flow. Pressure changes occurring in compressible fluid flow affect the physical properties of gases and vapors and consequently their flow behavior. Article discusses these differences and shows how to calculate flow relations for these systems.

Some Aspects of Solids-Gas Flow. Part 1. Introductory Concepts and Idealized Sphere Motion in Viscous Regime. L. B. Torobin and W. H. Gauvin. *Can. J. Chem. Eng. 37,* 129 (1959) Aug. (13 pp.)

Article introduces a series of analytical and critical literature surveys which deal first with the individual fundamental momentum transfer phenomena associated with particulate motion as affected by particle shape, roughness, acceleration, concentration and rotation, as well as the turbulence characteristics and boundary conditions of the transporting fluid. This information then will be used as a basis of discussion and interpretation of the many investigations of multiparticle solids-gas conveying systems and contacting techniques reported in the literature. This article reviews briefly some pertinent basic concepts of fluid mechanics, and then considers the development of the fluid velocity field and drag for single spherical particles moving rectilinearly at prewake-forming Reynolds Numbers through an infinite and undisturbed fluid.

Fractionation

Distillation . . . in View of Modern Developments. Part 2. Thermodynamics. K. F. Gordon and J. A. Davies. *Petrol. Eng. 31,* C-10 (1959) July (7 pp.)

PVT relationship is normally used for one of two purposes: 1) Estimate one variable when values for the other two are known and/or 2) use the relationship to derive values of thermodynamic functions such as the Joule-Thompson coefficient and the variation of enthalpy, entropy and specific heats with pressure or volume. Latter purpose, where derivatives of the PVT data may be needed, requires great precision. Role of thermodynamics in distillation is twofold: It allows energy balances to be made and equilibrium to be predicted.

Heat Transfer

Combined Geometric and Network Analog Computer for Transient Heat Flow. V. Paschkis. *J. Heat Transfer 81,* 144 (1959) May (7 pp.)

Method to analyze three-dimensional transient heat flow is described, which comprises a continuous resistance medium but discrete capacitances. After describing the principles of the technique, the several components and their criteria are discussed, and the accuracy is illustrated by comparing the results of several simple problems with analytically determined values.

The Effect of Surface Roughness on the Convection Heat-Transfer Coefficient for Fully Developed Turbulent Flow in Ducts with Uniform Heat Flux. R. T. Lancet. *J. Heat Transfer 81,* 168 (1959) May (7 pp.)

Experimental data are presented for the heat transfer coefficient and friction factor in a smooth and a rough duct with a hydraulic diameter of approximately 0.035 in. The flow was fully developed and turbulent, and the heat addition was uniform over the length of the tube. The rough tube indicated appreciable increases in heat transfer coefficient and friction factor. The smooth tube friction factors corresponded to rough tube values, indicating the difficulty involved in obtaining smooth surfaces for very small ducts.

Heat Transfer to a Boiling Liquid—Mechanism and Correlations. K. Engelberg-Forster and R. Greif. *J. Heat Transfer 81,* 43 (1959) Feb. (11 pp.)

Various heat transfer mechanisms which have been previously proposed are analyzed in the light of recent experiments. Evidence is presented in favor of a vapor liquid exchange mechanism. The mechanism is shown to explain the insensitivity of boiling heat flux to the level of subcooling. A "Reynolds' analogy" for nucleate boiling is presented in some detail. A procedure is given for calculating the superheat at which the liquid bulk velocity ceases to contribute to the heat flux. An expression for the growth of a vapor bubble in a highly superheated liquid is deduced. A method is presented which allows the deduction of correlations for nucleate boiling which give the dependence of heat flux on superheat and system pressure. Two such correlations are presented and results are compared with experiment. It is shown that one correlation yields the heat flux for different liquids varying from water to mercury, without necessitating any change in constant or exponent of the correlation.

Numerical and Machine Solutions of Transient Heat-Conducting Problems Involving Melting or Freezing. Part 1. Method of Analysis and Sample Solutions. W. D. Murray and F. Landis. *J. Heat Transfer 81,* 106 (1959) May (7 pp.)

Previously published methods for the solution of one-dimensional heat conduction problems with melting or freezing are briefly reviewed and weaknesses of previous analytic and numerical methods are outlined. Two new and more generally applicable numerical methods, applicable to digital and analog computation, are developed. Sample problems using these new techniques are solved and compared with the results of a widely used conventional method. An evaluation of the various methods and recommendations on areas of applications are included in the article.

Transient Response of Heated Air in an Enclosure with Heat Losses. W. A. Woolfe. *J. Heat Transfer 81,* 19 (1959) Feb. (3 pp.)

Transient temperature of well-stirred air in an enclosure with heat losses is investigated. Introduction of the heat capacity of the air results in nonorthogonal eigenfunctions for the differential equation of conduction. A method of determining the coefficients of the eigenfunctions is developed and the transient air temperature calculated for several values of the heat capacity of the air.

Wave Theory of Heat Transfer in Film Boiling. Y. P. Chang. *J. Heat Transfer 81,* 1 (1959) Feb. (12 pp.)

Article is an extension of author's previous work in which heat transfer was analyzed by the wave theory for natural convection and for nucleate boiling in detail and for film boiling in principle. In this work, heat transfer in saturated and subcooled film boiling from horizontal and vertical surfaces is analyzed from the viewpoint of the previously presented idea. By means of the concept of equivalent thermal diffusivity, a generalized Prandtl number is recommended. Thus a general formula is obtained for both convection and boiling. The predicted results agree well with the experiments of others.

Hydrocarbons

A Comparison of the Decomposition of Hexane and Cyclohexane by Different Types of Radiation. H. A. Dewhurst and R. H. Schuler. *J. Am. Chem. Soc. 81,* 3210 (1959) July 5 (3 pp.)

Hexane and cyclohexane have been irradiated with radiations having energy loss parameters from 0.02 to 5 e.v./A and the liquid products have been examined by gas chromatographic and infrared methods. In the preliminary study reported no change in overall decomposition is observed which can be attributed directly to a variation in the linear energy transfer of the radiation.

The Decomposition of Neopentane under Electron Impact. F. W. Lampe and F. H. Field. *J. Am. Chem. Soc. 81,* 3238 (1959) July 5 (4 pp.)

Appearance potentials are reported for the formation by electron impact of these various ions from neopentane: $t\text{-}C_4H_9^+$, $C_3H_5^+$, $C_3H_3^+$, $C_2H_5^+$, $C_2H_3^+$ and CH_3^+. Where possible ionization processes and/or heats of formation are deduced. The heat of formation of $t\text{-}C_4H_9^+$ is found to be 179 kcal/mole, which disagrees with the heretofore accepted value. The heat of formation of *t*-butyl radical is found to be about 2 kcal/mole, which agrees with published values within the limits of experimental accuracy. The new ΔH_f ($t\text{-}C_4H_9^+$) value is used to make a reinterpretation of the previously published value of the appearance potential of *t*-butyl ion from 3,3-dimethyl-1-butene, and from the reinterpretation it can be deduced that for the quantities $\Delta H_f(C_2H_3)$ and $D(C_2H_3\text{-}H)$ the values are 68 and 107 kcal/mole, respectively. The evidence concerning the neopentane decomposition modes provided by metastable ions is considered, and it is found that the metastable ion evidence and appearance potential evidence for the reactions producing the mass 27 and 39 ions are not in agreement. A discussion of the possible origins of the disagreement is given.

Partial Enthalpy Charts . . . for Light Hydrocarbons. A. J. Gully. *Petrol. Eng. 31,* C-3 (1959) July (5 pp.)

Need exists for enthalpy prediction methods which are both accurate and convenient. Charts contained in article are convenient for enthalpy prediction in light hydrocarbon systems at a pressure of 468 psia. Since small changes in pressure do not greatly affect enthalpy, these charts may be used for systems where the pressure differs appreciably from that value. Many deethanizers operate in this pressure range. Partial enthalpy data used was derived by Canjar and Edmister from the Benedict, Webb and Rubin equation of state. Since this equation has been found by many investigators to accurately predict PVT relationships, it appears theoretically that these values should be valid. No new data or correlating technique is presented. Value of the charts lies in the convenience of their use in process calculations.

Reaction of Gaseous Ions. VII. Methane-Hydrogen and the Proton Affinities of Methane and Ethane. F. W. Lampe and F. H. Field. *J. Am. Chem. Soc. 81,* 3242 (1959) July 5 (3 pp.)

Upper limits to the cross sections of gaseous ion reactions between methane and hydrogen are assigned. Upper and lower limits for the proton affinities of methane and ethane are estimated from existing knowledge of ion-molecule reactions that have been observed.

Hydrogen

The Heats of Vaporization of Para-Hydrogen and Ortho-Deuterium from Their Boiling Points to Their Critical Temperatures. D. White, J-H. Hu and H. L. Johnston. *J. Phys. Chem. 63,* 1181 (1959) July (3 pp.)

Heats of vaporization of hydrogen and deuterium have been measured from their boiling points to their critical points. Heats of vaporization of hydrogen deuteride and tritium have been predicted from the data, using a simple mass relationship.

Theoetical Performance of Liquid Hydrogen with Liquid Oxygen as a Rocket Propellant. S. Gordon and B. J. McBride. *Nat. Aeronautics Space Admin. Memo 5-21-59E.* (Washington: Nat. Aeronautics and Space Admin., 1959, June.) (139 pp.)

Theoretical rocket performance for both equilibrium and frozen composition during expansion was calculated at four chamber pressures (60, 150, 300 and 600 psia) and a wide range of pressure ratios (1-4000) and oxidant-fuel ratios (1.190-39.683). Data are given to estimate performance parameters at chamber pressures other than those for which data are tabulated. Parameters included are specific impulse, specific impulse in vacuum, combustion chamber temperature, nozzle exit temperature, molecular weight, molecular weight derivatives, characateristic velocity, coefficient of thrust, ratio of nozzle exit area to throat area, specific heat at constant pressure, isentropic exponent, viscosity, thermal conductivity, Mach number and equilibrium gas compositions.

Phase Equilibria

How to Get Numerical "K' Values. Part 2. S. B. Adler and D. F. Palazzo. *Chem. Eng.* 66, 123 (1959) July 27 (6 pp.)

Many expressions for the liquid vapor equilibrium constant, $K=y/x$, have appeared in the chemical engineering literature. There are special forms that apply to special conditions such as nonideal solutions, variation of standard state, deviation from the gas laws, etc. In previous article (see *Gas Abstracts 15,* 239) different forms of K were developed from basic thermodynamics and a summary table indicated how the forms are related. In this article it is demonstrated in four worked-out examples the practical applications of what has been discussed. These are: Determination of activity coefficients, determination of gamma for both components in the system propylene-ethane, calculation of K by various methods and determination of Henry's Law and Van Laar constants.

K's for Aromatics. D. S. Hoffman and J. H. Weber. *Petrol. Refiner 38,* 137 (1959) July (2 pp.)

Article presents vaporization equilibrium constants, K's, for toluene over the temperature range 60°-460° F, and to a pressure of 350 psia and for ethylbenzene and cumene over the same temperature range and to a pressure of 300 psia. In order to design units for any separation process in the processing of aromatic hydrocarbons, knowledge of these vaporization constants is necessary. In previous papers, authors have shown equations and methods of calculating the equilibrium vapor constants. These equations are presented and reader is referred to the earlier article for details of nomenclature, methods and discussion.

Thermodynamics

Applied Hydrocarbon Thermodynamics. Part II. Flow Calculations for Gases and Gas-Liquid Mixtures. W. C. Edmister and M. Ludwig. *Petrol. Refiner 38,* 161 (1959) July (8 pp.)

Flow of gases and of gas liquid mixtures, for which the density and temperature change appreciably with pressure, is an operation requiring the application of thermodynamic relationships and the exponents n′ and n, developed previously. Compressibility factors also are required. By using n′, n and Z, the compressible fluid flow calculations are derived for real, not ideal, gases. Three types of compressible fluid flow are of interest: Nozzle, pipe and diffusive. First two of these three fluid flow problems are considered after deriving the basic equations for a steady flow system.

Vaporization

An Additive Function of Entropy of Boiling, and the Prediction of Latent Heat of Vaporisation and Vapour Pressure of Liquids. L. H. Thomas. *J. Chem. Soc.,* 2132 (1959) June (21 pp.)

Additive function of entropy of vaporization is presented by means of which latent heat and vapor-pressure data of a given substance can be evaluated from a knowledge of its boiling point only. Treatment also leads to a plausible correlation of molecular structure and internal order in the liquid state.

Viscosity

Viscosity of Fluids at High Pressure. Rotating Cylinder Viscometer and the Viscosity of *n*-Pentane. H. H. Reamer, G. Cokelet and B. H. Sage. *Anal. Chem. 31,* 1422 (1959) Aug. (7 pp.)

Rotating cylinder viscometer suitable for measurements at pressures up to 25,000 psia in the temperature interval between 0° and 500° F is described. Experimental measurements which have been obtained for *n*-pentane are included as an example of the results to be expected with this instrument.

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